SEASONAL FOOD INSECURITY IN THE SAHEL:

nutritional, and socio- ~~social and~~ economic consequences ~~risk among~~
~~Bamana agriculturalists in Mali~~
for vulnerable agricultural households

by

Alayne Mary Adams

A thesis submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy in the Faculty of Medicine
University of London

London School of Hygiene and Tropical Medicine

March 1992

ABSTRACT

This thesis considers the nutritional, social and economic dimensions of seasonal food insecurity in Mali from the conceptual viewpoint of risk. It incorporates both longitudinal and cross-sectional designs, and quantitative and qualitative methods to explore the strategies agriculturalists employ to minimize risk, and the characteristics of the vulnerable.

Anthropometry, morbidity, adult energy expenditure, and household food consumption were monitored over a 14 month period in a village sample of 33 households to test the hypothesis that seasonal nutritional risk is experienced differentially by age and gender groups in the population. Significant seasonal changes were detected in all nutritional indicators, but few which exceeded threshold levels used to define risk.

At the household level, the thesis examines the hypothesis that exogenous factors and endogenous household characteristics combine to influence the range of strategies available to food insecure households, and therefore, the degree of risk they experience. Cross-sectional data on seven villages revealed striking interregional and interannual variations in the prevalence and severity of household food insecurity which are strongly related to rainfall.

Household stratification according to the capacity to sustain a secure, adequate and viable diet revealed the food secure to be large and wealthy households, with sufficient resources to diversify production, and to invest in agriculture and social networks of exchange. At the other extreme were food insecure households which tend to be poor, small and dependent on the proceeds of labour sales to breach the shortage period. Longitudinal study of food stock flows, labour exchange, monetary expenditure and other transfers, demonstrated the continuing vitality of social networks of exchange as means of spreading risk. Vulnerable households had less access to such networks.

TABLE OF CONTENTS

CHAPTER III: STUDY SITE

CHAPTER IV: SEASONAL FOOD INSECURITY AND NUTRITIONAL RISK

CHAPTER V: DETERMINANTS OF SEASONAL CHANGE IN NUTRITIONAL RISK

CHAPTER VI: SEASONAL FOOD INSECURITY AND THE HOUSEHOLD

CHAPTER VII: HOUSEHOLD FOOD SECURITY STRATEGIES

CHAPTER VIII: CLAIMS AND TRANSFERS DURING SHORTAGE

CHAPTER IX: CONCLUSIONS

APPENDICES:

LIST OF TABLES

LIST OF FIGURES

GLOSSARY AND CONVENTIONS

Glossary of Bamana terms used in text:

baaraden	hired worker
Bamana	Bambara people and culture
baninkɔ̀nɔ̀	stork
Bɛ̀lɛ̀dugu	a traditional Bamana region which coincides with the *Cercle de Kolokani*
bembe	wild grapes; *Lannea acida*
-bugu	suffix: town, settlement
buranci	in-law
cibɔ̀	youth labour group; ton
da	red sorrel; *Hibiscus sabdariffa*
danni kɛ̀	sow; seed
datu	traditional spice made from the African locust bean
du	household, compound, farm, extended family, house
dugu	land, soil; town, village, settlement
dugutigi	village chief
dukura	bush mango; *Cordyla africana*
dula	market trader
dutigi	household head
fabonda	pre-cold season (Oct-Nov)
fadenya	rivalry between co-wives/half-brothers
fɛ̀lɛ̀bo	collective hunt
fɛ̀rɛ̀	village centre/square
fonɛ̀nɛ̀	cold season (Dec-mid-March)
foro	field
forobaforo	main household field
fula	Fulbe (Fulani, Peulh) people and culture
furanfolo	brideprice
furasira	marriage road
garanke	leather worker
gɛ̀si	thresh
horon	free man
jakat	zakkat or muslim alms
jamu	surname, lineage
jatigi	host, landlord
jeli	praise-singer or bard
jɔ̀n	slave, individual
jɔ̀nforo	individual/private field
kafo	village federation, regional political territory
Kakolo	Kakolo people and culture
Kakolola	a *kafo* of Kakolo villages in the Bɛ̀lɛ̀dugu
kamalenforo	youth field
kɔ̀lɔ̀n susu	shea-nut processing
kule	wood carver
kungo	virgin bush

maabaforo	older men's field
mori	muslim cleric
muguni	physic nut; *Jatropha curcus*
n'tombolo	jujube berrry; *Ziziphus mauritiana*
na	sauce
nakò	garden
ngòyò	wild aubergine
numu	blacksmith
nyamakala	casted group in Bamana society
nyò	grain: millet, sorghum
samiya	rainy season (June-Sept)
sèbè	fruit of the raphia palm
senè kè	weed
so den	birth place
soroforo	house or compound field
soumbala	traditional spice
suna	early ripening millet
-tigi	suffix: head of --
tilema	dry/hot season (March-mid-May)
-w	suffix: denoting plural
waa bò	clearing
zaban	wild fruit; *Parinari exclas*

Glossary of French terms used in text:

arrondissement	administrative district smaller than a cercle yet larger than a secteur
cercle	administrative district smaller than a region yet larger than an arrondissement
region	administrative district larger than a cercle (Mali is divided into 7 regions)
secteur	administrative district smaller than an arrondissement

Currency Conventions:

Since September 1984, Mali has used the French CFA (FCFA) which is the common currency of most of French West Africa. During 1988-90 the exchange rate was approximately:

£1.00 Sterling = 500 FCFA; or $1.00 Canadian = 250 FCFA.

Orthography Conventions:

This thesis employs the orthography for Bamana as set forth by Bailleul (1981). The spelling of place names has been standardized in accordance with this convention. However, when quoting the literature, alternative phonetic spellings may be employed.

ACKNOWLEDGEMENTS

I am grateful to the Association of Commonwealth Universities for supporting my post-graduate studies in Great Britain, and to the International Development Research Centre (IDRC) for funding the field study. Grants from the Central Research Fund of the University of London, and the Overseas Research Studentship Programme are also gratefully acknowledged.

To the people of the Bèlèdugu I owe my greatest thanks. Young and old alike participated with patience, good humour and honesty despite the sensitive subject of research, and the intimacy of study methods. Possessing a remarkable instinct for both people and research, my principal assistant Salif Sow was instrumental in creating warm and productive rapport with the villagers with whom we worked, and from whom we learned so very much. Thanks is also extended to research assistants Michel Diawara and Fanta Coulibaly. I am grateful to the Centre D'Etude et de Recherche sur la Population pour le Developpement (Institut du Sahel) for providing institutional support throughout the field work in Mali; deserving special mention is the assistance provided by Mamadou Konate and the Director, Nassour Ouaidou.

My warmest appreciation to Boris Uhlela, Cameron Hall, and my parents Janet and Kenneth Adams for their unflagging help with data entry. I would also like to acknowledge the contributions of my colleagues with whom I have discussed, developed and clarified many of the ideas presented in this thesis: Larry Becker, Sarah Castle, Stephen Devereux, Elizabeth Dowler, Jeannine Fraser, Robert Leland, Nimal Ratnayare, Salif Sow and Shelly Sundberg. My supervisor, Simon Strickland provided invaluable guidance in the early stages of research, and timely orientation when I got 'lost' in subsequent analysis. I am extremely grateful for his comments on my thesis, and those provided by Martha Fulford, Wendy McLean, Donald Redelmeier and Paul Richards.

Finally, I am indebted to my friend Claudette Chase for providing a sense of perspective during the lonely task of writing-up, and to my colleague and companion Timothy Evans who has contributed to 'all of the above'. His intellectual and personal support have sustained me through the all too familiar cycle of trial, triumph and tribulation.

CHAPTER I: INTRODUCTION

1.0 Introduction

Implicit in the term adaptation is the notion of risk minimization; whereby adjustments are made to bring living organisms in viable relation to their environment. It might be expected that human populations exposed to seasonal fluctuations in food supply would develop biological, social and economic mechanisms to minimize the risk of dysfunction and maximize survival. Important in responding to seasonal food insecurity, therefore, is an understanding of the nature and adaptive limits of these adjustments. This thesis addresses the problem of seasonal food insecurity in the Sahel, exploring the biological, social and economic strategies employed to minimize risk, and the characteristics of those most vulnerable to the risk of dysfunction.

Seasonal food insecurity has been documented in diverse ancient and contemporary societies ranging from indigenous pre-industrial North America to the modern Indian subcontinent. In Africa, descriptions of the 'hungry season' are found in early anthropological studies of the Tallensi in Ghana (Fortes and Fortes 1936), the Bemba of Zambia (Richards 1939) and the Bamana of Segu, Mali (Labouret 1941). Later empirical surveys in Sahelian West Africa conducted by Pales (1954) in the French colonial Sudan, Fox (1953) and Haswell (1953) in the Gambia, and Hunter (1967) in north-east Ghana, confirm the persistence of 'seasonal hunger' or 'soudure' in the rainy season as pre-harvest food shortage coincides with an increase in energy expenditure related to agricultural work.

In the wake of the Sahelian famine (1969-73), the problem of seasonal food insecurity was revived in the literature: ethnographic explanations were offered by Ogbu (1973) and Nurse (1975), and overviews of the subject described its location (Annegers 1973), and nutritional effects (Schofield 1974). Specialized empirical studies have subsequently investigated seasonal variations in maternal nutrition, activity and lactational performance (Paul et al. 1979, Prentice et al. 1981, Roberts et al. 1982), seasonal patterns in morbidity and the growth of children (McGregor 1968, Rowland et al. 1977), seasonal fluctuations in body weight (Benefice and Chevassus-Agnes 1985) and the energy expenditure of agricultural workers (Brun et al. 1981, Bleiberg 1980, Haswell 1981), seasonal variations in food supply (Mondot-

Bernard 1980, Simmons 1976) and seasonal peaks in market prices and indebtedness (Hill 1972, Watts 1983).

Chambers et al. (1981) brought together these diverse aspects of the seasonal complex in their volume on seasonality and rural poverty. Characterizing the hungry season as a period when food stores are strained and prices high, time for meal preparation, child care and hygiene limited, energy needs for agricultural work at their maximum, and tropical disease prevalent, they argue that seasonally adverse factors interact to create and exacerbate rural poverty (Chambers et al. 1981).

Despite the recognition that the interaction of seasonal factors is critical to understanding seasonal food insecurity, subsequent research has largely continued to concentrate on single variables within the seasonal complex; the analytic problem of interaction circumvented by interdisciplinary books which compile collections of specialized chapters (Sahn 1989, Huss-Ashmore and Katz 1989). Indeed, the paucity of interdisciplinary empirical analysis and conceptual integration in the literature has led to misleading assertions that seasonal food insecurity neither matters nor exists (Miracle 1961), or conversely, that it is ubiquitous in dryland agricultural environments and the cause of great nutritional and socio-economic adversity (Annegers 1973).

Beyond the problems of definition, are those of measuring impact. It remains unclear to what extent transitory energy deficits precipitate adverse functional outcome in light of the adaptive capacity of the human organism. While it is assumed that household food insecurity and the nutritional risk of household members are related, few studies have investigated the nature of this association, or whether nutritional risk in one age/gender group may be extrapolated to the household as a whole. Although it is generally agreed that seasonal food insecurity affects households differentially, more research is needed to establish who is at greatest risk and why.

A growing literature examines the coping strategies of households and communities experiencing recurrent food insecurity, or worse still, food 'entitlement' failure of famine proportions (Sen 1981, DeWaal 1989). An applied theme in this literature is the attempt to identify patterns of behaviour useful for early-warning or targetting purposes (Watts 1983, Cutler 1984, 1986, Corbett 1988). Lacking is empirical data to support the hypothesis that households behave in a linear or sequential fashion. Also lacking in this literature is a systematic investigation of the role of interhousehold claims and transfers in minimizing the risk of food insecurity. While anthropology has explored the social and symbolic significance of reciprocity in a cultural context (Mauss 1950, Sahlins 1965, Laughlin 1974, Scott 1976, Dirks 1980), the challenging task of quantifying its material contribution to household livelihood remains.

Having located the problem of seasonal food insecurity with respect to the literature, Section 1.1 of this chapter describes the objectives and hypotheses of the present study. Section 1.2 clarifies several terms and concepts central to analysis, and Section 1.3 outlines how the thesis is organized in order to address the stated hypotheses.

1.1 Study Objectives and Hypotheses

Based on an interdisciplinary investigation of seasonal food insecurity in a dryland agricultural region in West Africa, this thesis attempts to address some of these deficiencies in the literature. Its micro-level focus facilitates the simultaneous investigation of various aspects of the food system, and the integration of nutritional, social and economic data. As its objectives, the thesis: 1) identifies the normative, nutritional and socio-economic character of food insecurity in the study region; 2) describes its onset, prevalence and severity during two consecutive shortage seasons; and 3) establishes the relative importance of risk-reducing strategies employed by agricultural households in response to food insecurity.

Five hypotheses guide the study design, two of which concern nutritional risk at the level of age and gender groups within the population, and three which address the issue of risk at the level of the household. With respect to the impact of seasonal food insecurity on nutritional risk it is hypothesised that: 1) seasonal nutritional risk is experienced differentially by age and gender groups within the population; and 2) that the human organism is capable of adjusting and recovering from seasonal episodes of mild to moderate nutritional risk without apparent adverse consequence. At the household level, it is hypothesized that: 3) exogenous factors (poor rainfall, high prices, unfavorable bio-geographic location) and endogenous household characteristics (poverty, small and undiversified labour force, isolation from social networks) influence the range of strategies available to food insecure households, and the degree of risk they experience; 4) notwithstanding the penetration of the market economy, social networks provide important insurance against seasonal food insecurity in dryland agricultural societies; and 5) seasonal food insecurity has critical implications for both the immediate welfare and future viability of vulnerable households especially in the context of successive years of production deficit.

1.2 Introduction to Terms and Concepts

This thesis considers the nutritional, economic and social dimensions of seasonal food insecurity in West Africa from the conceptual viewpoint of 'risk'. In its most general sense, the concept of **risk** refers to the probability of an undesirable event occurring. Implicit in the risk approach, therefore, is the quantitative measurement of both the frequency of an 'undesirable' event and its association with particular characteristics (risk factors), and the qualitative judgement of the 'undesirability' of that event (McLean 1984:17, Backett et. al 1984:8-9).

In the context of this thesis, the analysis or assessment of **risk** involves the investigation of the nutritional, social and economic outcomes of seasonal food insecurity, and the evaluation of the point at which they become undesirable or adverse. On the basis of this evaluation, it is possible to identify those individuals or groups of individuals among whom the probability of adverse outcome is greatest, hereafter known as **the vulnerable**, and to test for any associations between the degree of adverse outcome and particular characteristics (risk factors). In semi-arid agricultural environments where risk imbues every aspect of livelihood, risk-minimizing biological, social and economic strategies are necessary to ensure survival. This thesis investigates the nature and effectiveness of risk-reducing strategies, and considers how they might be enhanced or diversified to minimize vulnerability.

The term **seasonal food insecurity** refers to food shortage of a cyclical or transitory nature in which household food supply falls short of the physiological and perceived needs of household members. The cyclical character of **seasonal food insecurity** distinguishes it from chronic scarcity, such as famine-scale shortage, or occasional scarcity as might occur with an adverse event such as crop infestation by locusts. The problem of seasonal food insecurity tends to be most marked in tropical agricultural environments with a single rainfall maxima and a unimodal cropping schedule. In dryland agricultural societies, it usually coincides with the rainy season before the harvest when cereal stores are low or empty and other means of procuring cereal constrained.

In the absence of a universally agreed upon definition of **household**, to facilitate sampling and subsequent analysis, this thesis employs its simplest conception as an eating or consumption unit. In the context of the present study, an eating unit is comprised of individuals who eat from the same pot, or more specifically, of individuals who farm a common field and who have rights to consume grain drawn from a common granary (Meillasoux 1981). However, as Chapter VI stresses, the use of the household as the primary focus of analysis does not preclude consideration of gender and generational dynamics within the household, or the interhousehold networks in which it operates.

1.3 Thesis Outline

In order to address the study hypotheses presented in Section 1.1, the thesis moves from the analysis of nutritional risk at the level of age and gender groups in the study population, to a broader investigation of nutritional, social and economic risk at the level of the household. Chapter II presents field study methods for pilot, cross-sectional and longitudinal stages of data collection, and the statistical techniques and assumptions employed during data analysis. In Chapter III, the study site is described in terms of its location and its historical, political, economic and ethnographic context. Chapter IV considers the impact of seasonal food insecurity on nutritional risk at the level of age and gender groups within the study population. This is followed by Chapter V which investigates three possible determinants of seasonal variation in nutritional risk (household food consumption, energy expenditure and morbidity) and their interaction.

Chapters VI, VII and VIII concern seasonal food insecurity viewed at the household level. Chapter VI documents its onset, prevalence and severity in the study region. An indicator of food insecurity is developed in order to stratify households according to risk. In turn, this classification scheme is used to elicit the endogenous demographic, socio-economic, nutritional and allocative characteristics of households at greatest risk of insecurity. Chapter VII evaluates the relative contribution of food security strategies to household consumption, investigating interregional and interannual variations in strategies employed and their accessibility to food insecure households. The notion of sequencing is also explored. Chapter VIII considers social networks of exchange and their role in minimizing risk in rural agricultural society. It explores the manner in which social relations within and between households and extra-village relations in the locality and larger spheres of market and state define social networks of exchange. Classifying food claims and transfers by type, the chapter investigates the nominal rules which guide their operation and their quantitative contribution to household subsistence in the context of insecurity. Chapter IX provides a synthesis of results in light of the study hypotheses. It concludes by considering some of the implications of the study for research, policy and practice.

CHAPTER II: FIELD STUDY METHODS

2.0 Introduction

A micro-level research methodology was considered the most appropriate means of responding to the hypotheses articulated in Chapter I. Bamana agriculturalists in Mali were chosen as the focus of investigation: a group known to experience seasonal fluctuations in food supply typical of mono-cropping tropical environments, and prone to periodic food crises given the climatic variability of the Sahel.

The study incorporates both cross-sectional and longitudinal designs. A broader perspective on the problem of seasonal food insecurity and the particular importance of food claims and transfers in relation to other food procuring strategies is afforded by a cross-sectional survey of 148 households in seven villages. By contrast, a longitudinal study of a small sample of households over a 14 month period from the harvest of 1988 to the subsequent harvest of 1989 permits nutritional, social and economic variables to be assessed in the comparative context of an entire annual cycle.

This chapter considers the methods employed in the field study. Sections 2.1 to 2.3 present pilot, cross-sectional and longitudinal study techniques. The periodicity of the different types of data collection is summarized in Table 2.0. Section 2.4 describes the statistical techniques and assumptions employed during data analysis.

Table 2.0 The Periodicity of Field Study Methods

method	jun88	oct88	nov88	dec88	jan89	feb89	mar89	apr89	may89	jun89	jul89	aug89	sep89	oct89	nov89
pilot study (2 wks)	x														
1st cross-sectional survey (1 mon)		x													
whole household anthropometry (1x mon)			x	x	x	x	x	x	x	x	x	x	x	x	x
hhold fd consumption (2x season)			x	x			x	x			x	x			
time allocation of active adults (6x mon)			xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	
household morbidity (2x mon)			x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	
household food stocks (2x mon)			x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	
household expenditure (2x mon)			x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	
household labour exchange (2x mon)			x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	x-x	
kinship (1x yr)					x										
granary stores (1x yr)						x									
household assets (1x yr)								x							
food behaviour (1x yr)									x						
agricultural org (1x yr)														x	
income sources (1x yr)														x	
2nd cross-sectional survey (1 mon)															x

2.1 Pilot Study

A pilot study of preliminary questionnaires and methods was undertaken in June 1988. With the assistance of researchers at the *Institut du Sahel* and officials in the *Cercle de Kolokani*, a village was chosen approximately 150 kilometres due north of Bamako. Research authorizations, transport and the services of a field assistant were secured through the *Institut*.

During the two week period, both village and household questionnaires were administered and amended in content, length and plan. Longitudinal methodologies were also pre-tested and revised. A 3-day food intake technique designed to measure consumption at the level of age and gender groups was attempted, but abandoned as unfeasible given the complexity of communal eating practises[1]. Instead, it was decided that measurements of household-level food consumption would suffice to capture seasonal variations in the quantity and quality of household diet. Anthropometric techniques were practised on a range of individuals to determine the ease and speed at which measurements could be conducted. Minute by minute

[1]In Bamana society, men and women customarily eat separately, and within each gender, various age-groupings eat communally out of the same bowl.

observations of activity were also performed to determine how demanding a 15-hour period of observation was for both participant and observer.

The pilot study proved indispensable, permitting methods to be fine-tuned to the cultural and logistical context of the study region. Village inhabitants were both hospitable and extraordinarily patient with novice attempts at research design.

2.2 Cross-sectional Survey Methods

Two cross-sectional surveys were performed at the beginning (October 1988) and end (November 1989) of the field study period to provide a broader perspective on seasonal food insecurity in the region, and to help establish the representativeness of the subsequent longitudinal study.

a) Village Sample Selection

On the basis of demographic, rainfall, livestock and crop production data, a study region was identified in the *Cercle de Kolokani*, locally known as the *Bèlèdugu* (Mali 1985). This region best fit the criterion established to guide sample selection; being of homogenous Bamana ethnicity where semi-subsistence agriculture is the primary productive activity, and seasonal food insecurity a generalized and recurrent phenomenon. According to Walsh's indices of rainfall seasonality, the region is highly seasonal in character, having a dry season of 8-9 months in duration, and a seasonality index of 1.00-1.19 (Walsh 1981)[2].

Using a draft copy of the 1987 census report (provisional results), and government survey maps as reference, village sampling began by considering the *cercle* in terms of its 5 constituent administrative/geographic districts or *arrondissements*. A list of villages was

---

[2]Walsh (1981:14) defines 'relative seasonality' as the sum of the absolute deviation of mean monthly rainfall from the overall mean, divided by mean annual rainfall. In theory, this index may range from 0 if all months have the same amount of rainfall, to +1.83 if rainfall is concentrated in a single month.

compiled for each *arrondissement* taking care to choose villages of average size (25-50 households) to facilitate subsequent household sampling. Based on this list, criteria such as the presence of basic infrastructure (medical and educational facilities, market), and proximity to larger commercial centres, were applied in order to select a final sample of 7 villages which represents a microcosm of the *cercle:* 3 villages were chosen from the larger *arrondissement* of Kolokani-Central, and one village from each of the 4 smaller *arrondissements.* Table 2.1 presents the selection criteria used in choosing the village sample.

Table 2.1 Criteria Guiding Village Sample Selection: Cercle de Kolokani (Bèlèdugu)

village	arrondissement	climate	pop 1987	# of hh's	infrastructure med/edu/market	proximity to centre
Kossumale	Kolokani Central	sud-sahel	383	30	- - -	25 km
Sèbèkoro	Kolokani Central	sud-sahel	375	41	x x x	45 km
Falakan	Kolokani Central	sud-sahel	184	17	- - -	8 km
Dubala	Didieni North	sud-sahel	383	28	x x -	40 km
Bala	Didieni Central	sahel	293	27	- - -	6 km
Zambugu	Nussombugu	sud-sahel	410	39	- - -	7 km
Fonfilèbugu	Massantola	sud-sahel	478	24	- - -	24 km

• sud-sahel= sudano-sahelian zone with an average annual precipitation of 800-1000 mm;
sahel= sahelian zone with an average annual precipitation of 600-800 mm.

b) Household Sample Selection

With the assistance of the village chief in each of the seven villages, a numbered list of agricultural households residing in the village was compiled, and a table of random numbers used to identify a sample of 20 households. This was accomplished in each of the villages with the exception of Falakan which consisted of only 17 households, and the village of Sèbèkoro (site of the longitudinal study), where all 33 agricultural households were included.

The same households participated in the first and second cross-sectional surveys with the exception of two households in Dubala which had left the village permanently at the time of the second survey in 1989. Excluding these two missing households, a total of 148 households were interviewed in both surveys.

c) Questionnaire Design and Administration

i) first cross-sectional survey (October 1988)

On arrival in each village, an audience with the village chief was sought in order to explain the purpose of the survey. A meeting of household heads was convened that evening or the following morning at which time formal introductions were made, and a village level questionnaire administered to elicit background information on village history, infrastructure, and social organisation.

Following this, the research assistants would arrange morning and afternoon household interviews for the subsequent four days. To begin, a detailed household census was conducted which identified the age, gender, health status, occupation, residence and relationship to the household head for all household members. Absent household members were recorded separately, taking note of the date and reason for their departure, and the anticipated duration of their stay away from the household.

The household questionnaire began by surveying the village origins of married women, the location and identity of patrilineal kin, and household participation in village-level work associations. The next section considered household perceptions of food insecurity and the history of food crises experienced by the household. The last section evaluated household food stocks and material and productive assets. The principal investigator verified completed questionnaires in the field so that uncertainties could be clarified as they occurred. Cross-sectional questionnaires are annexed in Appendix I.

ii) second cross-sectional survey (November 1989)

In November 1989, a second cross-sectional survey was undertaken in the same village sample as the year previous. Once again, a household questionnaire was employed, however unlike the previous survey, it was less formal in design, using dialogue to elicit detailed information on soudure periods in 1988 and 1989.

This methodological approach evolved as a result of experience in the longitudinal field study. Familiarity with the study milieu revealed story-telling and informal dialogue to be particularly effective methods of gathering information; unlike the 'questionnaire approach' which tended to confine the scope and context of discussion to the point that responses became abstract, the 'dialogue approach' focused more on the informant's actual experience. Indeed, when questionnaire and dialogue accounts of the soudure of 1988 were compared, there was a consistent tendency for informants to exaggerate the severity of food crisis using the questionnaire, while informal dialogue concerning the details of household food procurement and consumption during the same soudure period yielded a far more tempered account.

The dialogue began by establishing the level of production sufficiency for each household, and perceived reasons for this level of sufficiency or insufficiency. In the case of production deficient households, further discussion concerned the degree of consumption insecurity they experienced. This was accomplished in a semi-structured manner by asking the informant to trace a chronological history of consumption events (cereal purchases, gifts and credit, changes in the quality and quantity of household food consumption, etc.) using the agricultural calendar as reference (see Appendix I). Following this account, information on the nature, timing and consequences of particular food procuring strategies was elicited.

d) Research Assistants

Two university graduates with survey experience were employed as research assistants for both cross-sectional surveys.

2.3 Longitudinal Study Methods

From the cross-sectional sample, a single village was selected for longitudinal study from November 1988 to the following November 1989. The choice of Sèbèkoro was based on the high prevalence of seasonal food insecurity reported in the village in 1988. Its weekly market greatly facilitated data collection and the continual presence of team members at the study site as most supplies could be procured without leaving the village.

a) Sample Selection

To facilitate the identification of village networks and the monitoring of transfers between households, the longitudinal sample included all agricultural households in the village. The households of teachers (5) and health and agricultural extension workers (3) were excluded from regular data collection, leaving a final sample of 33 households. However, linkages between public servants and sample households were considered in the investigation of inter-household claims and transfers.

b) Quantitative Methods

Formal quantitative methods involved once-monthly whole household anthropometry, seasonal household food consumption measurements, monthly time allocation observations of active adults, and twice-monthly monitoring of household morbidity, food stocks, expenditure, and labour exchange (Table 2.0). In view of the difficulties associated with retrospective methodologies, the two-week recall period was carefully defined with reference to local events (ie. market and communal labour days) such that the information collected seemed a reasonable reflection of major flows of household food, labour and expenditure.

i) anthropometry

As proxy indicators of nutritional status, anthropometric measurements were used to investigate the influence of seasonality on the nutritional status of age and gender groups in the study population (Chapter IV), and the association between household food insecurity and the nutritional risk of age and gender groups within the household (Chapter VI)[3].

In order to minimize observer error, quarterly measurements of height, and monthly measurements of weight, mid-arm circumference and adult skinfolds were made by the principal investigator accompanied by both research assistants. At the beginning of each

[3]The use of anthropometry over other indicators of nutritional status is justified in Chapter IV.

month, the study team circulated between households in the early morning and late afternoon, covering the sample population of ~370 individuals in approximately four to five days. As such, measurements were interpreted as the outcome of the previous month. Anthropometric instruments were cleaned and checked regularly.

Using a mechanical Seca bathroom scale, monthly measurements of body weight were made on all household members in the sample prior to the morning or evening meal, with shoes and heavy clothing removed[4]. A suspended Salter spring scale was used for small children unable or unwilling to mount the Seca scale. In both cases, two separate measurements of weight were made and averaged to the nearest 0.5 kilogram.

Duplicate height measurements were made to the nearest 0.5 cm using a portable stadiometer with spirit level, or in the case of children under two years of age, supine measurements were made using a wooden length board. In the case of children and adolescents, height was measured quarterly and extrapolated for intervening months, while adult height was represented by the average of measurements made at beginning and end of the study. Because the study team often had to travel to the fields or other villages to make measurements, the portability of equipment was an important consideration.

Monthly skinfold measurements (triceps, biceps, subscapular and supra-iliac crest) were performed on the adult population to provide a more sensitive gauge of seasonal changes in body composition. Mid-arm circumference was measured on the left arm by marking the midpoint between the edge of the acromion and the summit of the olecranon process using a steel tape. Skinfolds were taken with reference to the midpoint markings using Holtain calipers which apply constant pressure of 10 g/mm^2 to the skin surface (Gibson 1990). Readings were made in duplicate to the nearest 0.1 mm and the two results averaged.

Accurate age data for children under five was obtained from birth registers kept at the maternity clinic. In cases where birth records were missing, ages were inferred with reference to children born at the same time, and local events.

---

[4]Compliance with monthly measurements was had by 99% of individuals in the sample population.

ii) household food consumption

Household food consumption data was collected to help interpret seasonal variations in nutritional risk as indicated by anthropometry (Chapter IV), and to investigate the relationship between seasonal intake and household food insecurity (Chapter V).

Direct measurements of household food consumption were made twice in each seasonal period; the mean of which was used to represent household dietary intake in harvest, dry and rainy seasons respectively. Prior to each meal, dry sauce ingredients were weighed to the nearest 5 g using a 1 kg capacity Salter dietary scale. Cereal measurements were made at the final stage of processing prior to cooking using a 5 kg capacity Salter scale. Dry weights were recorded to the nearest 20 g[5].

Snacks and food gifts received and/or given were measured whenever possible to supplement daily intake records. In cases where these occurred in the absence of the investigator, quantities were recalled or estimated. Energy and nutrient information was extracted from food tables pertinent to Malian diet (FAO 1970, 1988, McCrae and Paul 1979, Mondot-Bernard 1980, Watt and Merrill 1963, West et al. 1988, Wu Leung et al. 1961, 1968, 1972)[6].

To facilitate interhousehold and interseasonal comparison, total energy expenditure is expressed per consumption unit (cu), the derivation of which is presented in Appendix V. Seasonal household consumption units were calculated by summing up the cu's of individual household members at three seasonal points. For each meal, these seasonal cu figures were adjusted upwards to take into account the age and gender of visitors, and downwards to correct for absent household members.

---

[5]In cases where sorghum or millet were slightly damp prior to cooking, adjustments were made for moisture content based on correction factors derived from repeated measures of moist and dry cereals of different types and consistencies.

[6]More recent sources were preferred due to advances in nutrient analysis techniques, as were sources which compiled analyses of foods of African origin in particular. The food composition tables used for analysis are found in Appendix III.

In addition to weighed household intake, transactions (sales, purchases, exchanges and gifts given/received) occurring during the measurement day were recorded as were the number and type of meals prepared in the previous two days.

iii) time allocation of active adults

Continuous 15-hour observations of active adult men and women were undertaken to facilitate the interpretation of seasonal variations in nutritional status. Although participants were selected randomly, no one individual was observed twice. Throughout the 15-hour period, a minute by minute record of activities, work intensity and climatic conditions was kept. Six observations (3 male/3 female) were performed each month by the study team.

Energy expenditure was computed by multiplying the amount of time spent in each activity with its energy cost based on indirect measures of oxygen consumption by Brun et al. (1981, 1984) and Bleiberg (1980)[7]. The unobserved part of the day (9 hrs) was assumed to have been spent asleep or in a near basal state (1.0*BMR). Basal Metabolic Rate (BMR) was predicted using equations provided by FAO/WHO/UNU (1985:71). In the case of activities not measured by Brun and Bleiberg, other sources were consulted and/or best estimates made (Durnin and Passmore 1967, Altman and Dittmer 1968, Montgomery and Johnson 1977, Lawrence et al. 1985). Appendix IV presents the energy costs of male and female activities used in analysis. These activities were coded and organized into functional categories, and averaged per season.

iv) morbidity

In tandem with information on household food consumption and seasonal patterns of energy expenditure, morbidity data was collected to help interpret seasonal variations in the nutritional status of age and gender groups. Additionally, given the possible welfare effects of ill-health, it was important to investigate its impact on the food security of agricultural households. Permitting informants to interpret the concept of illness in their own terms, data collection

---

[7]Using indirect calorimetry, Brun and Bleiberg (1980, 1981) measured the energy cost of specific activities performed by a group of Mossi agriculturalists which closely resemble the study population in terms of physical, socio-economic and occupational characteristics.

consisted of recording illness episodes as self-defined and self-reported. Twice monthly, any illness experienced by individuals within the household was recalled according to its symptoms, duration, whether it resulted in days off work, or incurred any treatment costs.

v) food stocks

Inflows (purchases, salaries in kind, staple loans and gifts received, domestic production) and outflows (sales, salaries paid in kind, staple loans and gifts given, domestic consumption) of cereal were monitored twice monthly to provide a quantitative estimate of the origins and security of household food stocks.

Participant households were asked to estimate these flows in kilograms. In view of possible error in estimating food stocks in this manner, an independent measure was obtained by calculating the volume of cereal in the household granary following the harvest (see Appendix II). A strong positive correlation between recalled cereal stocks and measured cereal stores was detected ($r=0.81$) which substantiates the reliability of recall.

vi) household expenditure

Household monetary expenditure was monitored twice monthly to provide a quantitative indication of household allocative strategies. The recollection of expenditure was greatly facilitated by the presence of a weekly market when most purchases were made.

vii) labour exchange

To assess the importance of labour mediated food transfers, the receipt and provision of labour between households was monitored throughout the study. Twice a month, the identity and number of labourers received and provided by the household were recalled by the household head. The reasons why labour was furnished, the task, duration of work accomplished and the mode of payment were also solicited.

viii) other transactions

Transfers of agricultural equipment, livestock and money were monitored throughout the agricultural season by taking note of the items exchanged, relations between giver and recipient, and the terms of each transaction.

c) Qualitative Methods

Informal investigations of kinship, food behaviour and agricultural organization took place in the post-harvest season when informants were less occupied and more familiar with the study team. Household history and kinship relations were examined by means of informal discussions with household members. Food behaviour was explored through semi-structured dialogues with married women concerning food preferences, child feeding practises and food-procuring responsibilities. Household agricultural organisation was similarly investigated through loosely structured interviews with members of the active agricultural labour force in each household, as were seasonal income sources. An inventory of household assets was compiled informally given widespread sensitivity to overt declarations of wealth[8].

d) Research Assistants

Two research assistants, one male and one female, were employed for data collection. The female assistant was responsible for seasonal food consumption measurements. The principal investigator provided training during the first round of measurements, and supervised subsequent measurements closely. The male assistant monitored food flows, expenditure, labour exchange and morbidity, assisted the principal investigator during informal inquiries, and oversaw the field study in her absence.

[8]While this may be partly due to Bamana pretences towards egalitarianism (Lewis 1979), many agriculturalists fear that undeclared assets may be reported to taxation officers.

e) Informant Relations

Despite efforts to convey the purpose of 'research', villagers were perplexed by the study's concern with the minutia of daily life. For the most part, however, researcher-informant relations remained amiable and productive throughout the longitudinal study. Given the invasive and protracted nature of the study design, confidentiality and good humour were important to maintain.

The investigation of exchange relations did not preclude participation in these networks. Indeed, the giving and receiving of gifts was essential to good relations with village informants. Small gifts of cola nut, sugar and salt were made periodically to participant households as were token contributions at ceremonial occasions such as baptisms, initiations and marriages. During food consumption measurements, women responsible for meal preparation received several beef stock cubes in thanks for their participation.

In June, seven ploughs were purchased by the study and distributed according to greatest need. In addition, all households received a small gift of millet during in the month of July. Made for ethical reasons, concerns that this gift would interfere with study results were allayed given the availability and low market price of cereal during the soudure season of 1989.

f) Biases in Study Design

Given that many of the study methods relied on the ability of the informant to recall qualitative and quantitative details concerning expenditures, cereal and labour transactions etc., it is reasonable to question the accuracy and validity of the information provided. It is also inevitable that the perceptions and motivations of both researcher and informant influenced the questions asked, responses given and their subsequent interpretation.

While these biases are acknowledged, every attempt was made to minimize their influence: suspect data was verified whenever possible, and efforts to establish a rapport of trust, respect and patience greatly facilitated the reliable exchange of information.

2.4 Data Analysis

a) Data Coding and Entry

Once the field study had concluded, questionnaires, inventories and recording forms were coded by the principal investigator. Paradox 3.0 was used for data entry and cleaning, while the statistical package SPSS/PC+, Version 3.1 was employed for data analysis.

b) Statistical Methods

i) data investigation

Prior to analysis, the distribution of continuous and discrete variables were investigated through the computation of means, modes, standard deviations, measures of normality (skewness and kurtosis) and linearity. On the basis of these distributions, groupings and cutoff points for certain variables were chosen, the creation of other aggregate variables justified, and appropriate statistical tests selected.

ii) correlations

Robust to departures from normality and homogeneity of variance, Pearson product moment correlations permit the measurement of association between pairs of variables. Measuring the covariance between x and y variables relative to the square root of the product of x and y variances, Pearson correlations were used at various points in analysis to identify strong associations between variables which were further explored through one-way or multivariate analysis of variance (Tabachnick and Fidell 1989).

iii) one-way analysis of variance

Reasonably robust to violations of normality and homogeneity of variance, parametric one-way analysis of variance (ANOVA) was used in analysis to detect statistically significant differences between the means of a single dependent variable, by groupings of a independent variable. Evaluating differences among means relative to overlap in sampling distribution, ANOVA compares the ratio of two estimates of variance: the numerator represents differences within each group (random or error variance), while the denominator represents differences between group means plus error. If these two estimates of variance do not differ appreciably, the null hypothesis is affirmed; that group means come from the same sampling distribution of population means and the slight differences between them are due to sampling error alone (Kirkwood 1988). If, on the other hand, group means differ more than expected, it is concluded that they are drawn from different sampling populations and the null hypothesis is rejected. In the case of analyses which contain three or more groups, Scheffe's procedure was used to locate significant pairwise differences in group means.

In the case of non-normally distributed variables, Kruskal-Wallis one-way analysis of variance was preferred. An extension of the Mann-Whitney Test, group cases are combined and ranked; averaged ranks being assigned in the case of ties. For each group, ranks are summed and the Kruskal-Wallis H statistic is computed which closely resembles a chi-squared distribution. While less powerful than parametric one-way analysis of variance, a test of the null hypothesis that groups come from the same population is provided (Siegel 1956).

In the case of multiple dependent variables, multivariate analysis is preferred as it takes into account the complex interaction between variables which may result in inflated Type I error. When the absence of a multivariate normal distribution precludes the use of multivariate techniques (i.e. in Chapter VI), univariate alpha levels must be adjusted to take into account the number of dependent variables being tested. Caution is also required in the case of intercorrelated dependent variables, the overlapping variance of which may result in spurious significance.

iv) repeated measures analysis of variance

An application of multivariate analysis, repeated measures analysis of variance (repeated MANOVA or the profile approach to repeated measures design) was used to analyze the statistical significance of seasonal variation in Chapters IV and V. Unlike the mixed model approach, repeated MANOVA makes no assumptions about the patterns of covariances (correlations) between repeated measurements. Indeed, its only assumption is that the variables sampled be drawn from a multivariate normal distribution (Hertzog and Rovine 1985).

In a 'repeated measures' or 'within-subject' design, special procedures are used which incorporate dependencies encountered when multiple observations are made on the same experimental unit over time. By controlling for between-subject differences (i.e. eliminating the variability due to differences between subjects from experimental error), a more powerful test of the hypothesis is produced than would be afforded by a between-subject design.

Unlike univariate analysis or the multiple paired t-test, the repeated measures design permits the evaluation of mean differences on all of the dependent variables simultaneously, while controlling for the intercorrelations among them (Bray and Maxwell 1985). Analysis is performed on transformed variables derived from linear combinations of differences between seasonal variables called 'contrasts'.

In addition to the single test of the hypothesis provided by the repeated measures design, univariate f-tests for individually transformed variables are also examined to help identify which individual 'contrasts' contribute most to overall differences. However, because the observed significance levels for the individual parameters are not adjusted for the fact that several comparisons are made, they may only serve as guides for identifying important differences (Norusis/SPSS INC 1988).

v) Causality

As with all statistical procedures, attribution of causality to an independent variable is no way assured by the statistical test. For example, if there is a systematic difference in a dependent variable associated with levels of an independent variable, the two variables are said to be **related**, however, the **cause** of the relationship is unclear. The need for caution regarding the attribution of causality is particularly relevant to this thesis where independent variables are designed by the investigator, and the desire for causal inference is part of hypothesis testing (Tabachnick and Fidell 1989).

c) Stratification

Given the variable and erratic distribution of rainfall in this Sudano-sahelian zone, and concomitant fluctuations in the prevalence and severity of household food insecurity, household stratification occurred post-facto (Reardon et al. 1988). Various methods of classification were considered in the course of data collection and analysis. Stratification using wealth or income indices was rejected due to the difficulty of evaluating livestock holdings, the irregular character of migrant remittances and other income sources, and the irrelevance of traditional indicators of wealth in a society where kinship relations, lifecycle stage and labour force are integral to household welfare.

The use of production sufficiency as a basis for classification failed to distinguish between production insecure households which were able to meet household subsistence needs, and those which could not. Classification on the basis of production sufficiency was further complicated by the existence of households which relied exclusively on cereal purchases and/or cereal gifts.

In view of the inadequacy of conventional methods of classification, an alternative means for stratification is developed in Chapter VI which employs indigenously defined indicators of consumption insecurity to identify households at greatest risk (see Section 6.2b). In keeping with the indigenous view that the full granary represents a state of food security, households with sufficient domestic production to last the year constitute the first group. The second group is comprised of households which lack sufficient domestic production reserves to last the year, yet are able to sustain **normal** household diet through alternative food-procuring strategies. The indigenous indicators used to identify a **non-normal** diet, and therefore households most vulnerable to food insecurity, are rationing and the consumption of wild foods in place of cereal. Households obliged to resort to these strategies form the third, or food insecure group.

CHAPTER III: STUDY SITE

3.0 Introduction

This chapter begins by describing the study site in terms of its geographic location and rainfall patterns (Section 3.1.). The historical, political and economic context of the study region is outlined in Section 3.2, followed by a synopsis of its current population, health and nutrition situation. The ethnic character of the study site is described in Section 3.4, while Section 3.5 focuses on the ethnographic details of household production and reproduction among the Bamana. In Section 3.6, the study villages are presented in turn.

3.1 Location and Rainfall Patterns

The Republic of Mali is a land-locked nation in the centre of West Africa which straddles Sahara, Sahel and Sudanic climatic zones. Rainfall varies from less than 200 mm per annum in the northern Sahara, to 1400 mm in southern Sudanic areas. Located 130 kms due north of Bamako in the *Cercle de Kolokani*, the study site spans Sahelian and Sudanic zones with a mean rainfall of 600-800 mm (Figure 3.0).

Analysis of climatological trends in the Sahel indicates a dramatic decline in rainfall since independence in 1960 (Albergel and Grouzis 1985, Lamb 1980)[1]. Severe meteorological droughts have been experienced in 1969-73, and 1984-85, both of which have contributed to a decline in per capita agricultural production, a doubling of food imports, as well as a deterioration in the balance of payments (FAO 1989, Giri 1989)[2].

---

[1]Analyzing rainfall data from the Sahel region, Albergel and Grouzis (1985) identify three periods characterized by general patterns of precipitation: 1) a period of average rainfall from 1930-49; 2) a period of abundant rainfall from 1950-68; and 3) a period of insufficient rainfall from 1969 onwards.

[2]Glantz (1987) defines a meteorological drought as a period of rainfall which is 25% below the long-term average for the region.

Figure 3.0 Map of Mali

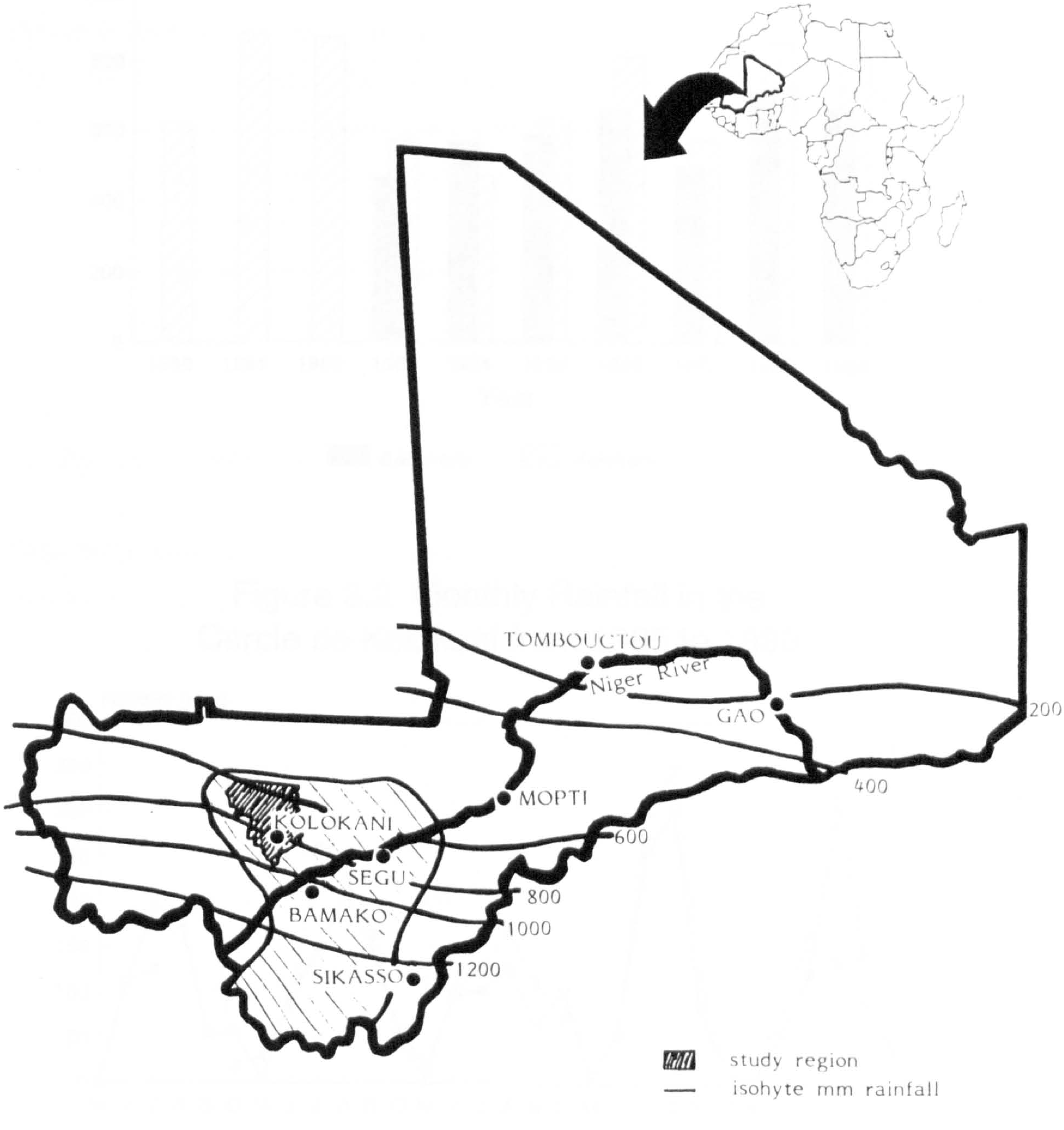


Figure 3.1 Annual Rainfall in the Cercle de Kolokani, Mali, from 1980 to 1989

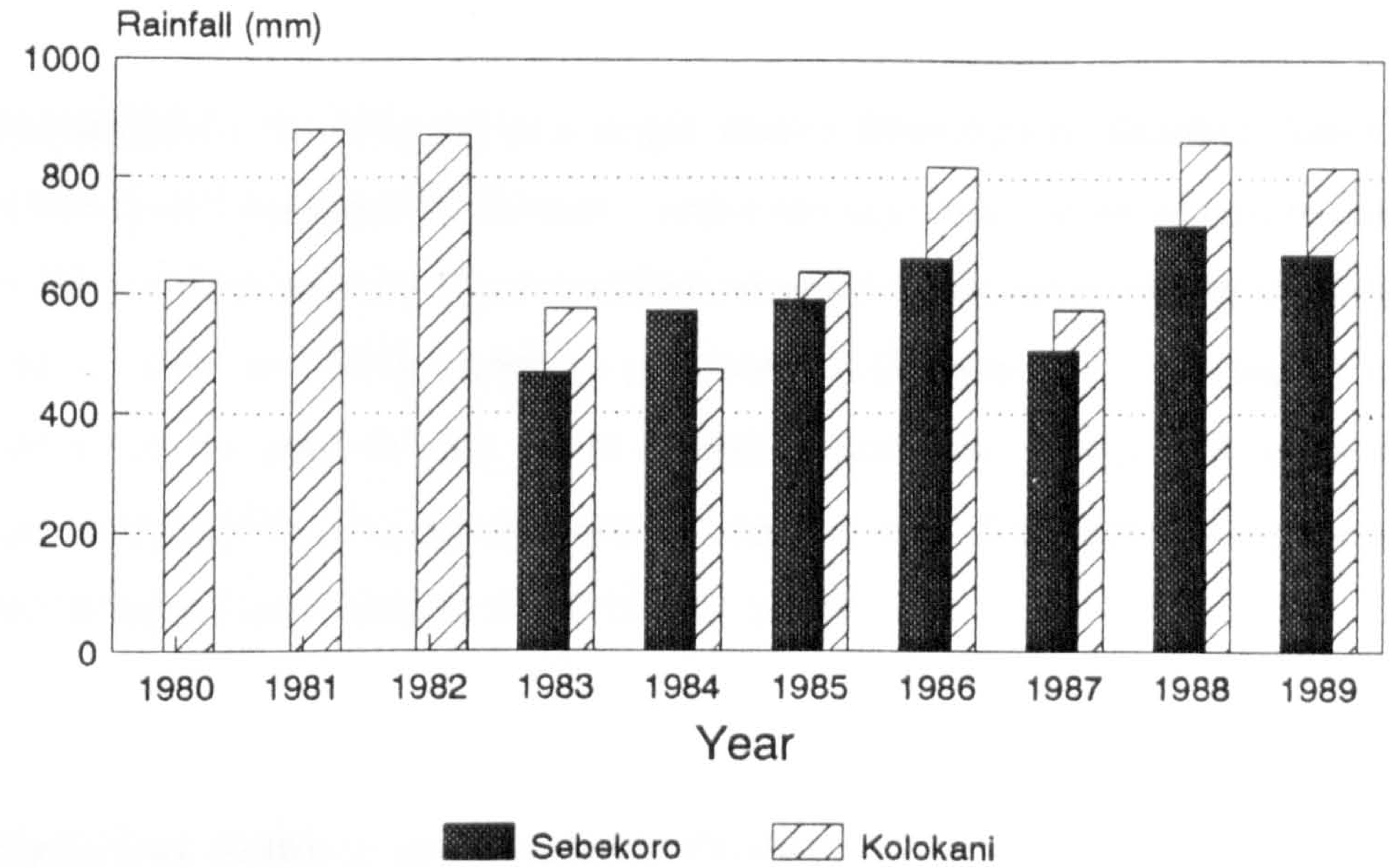
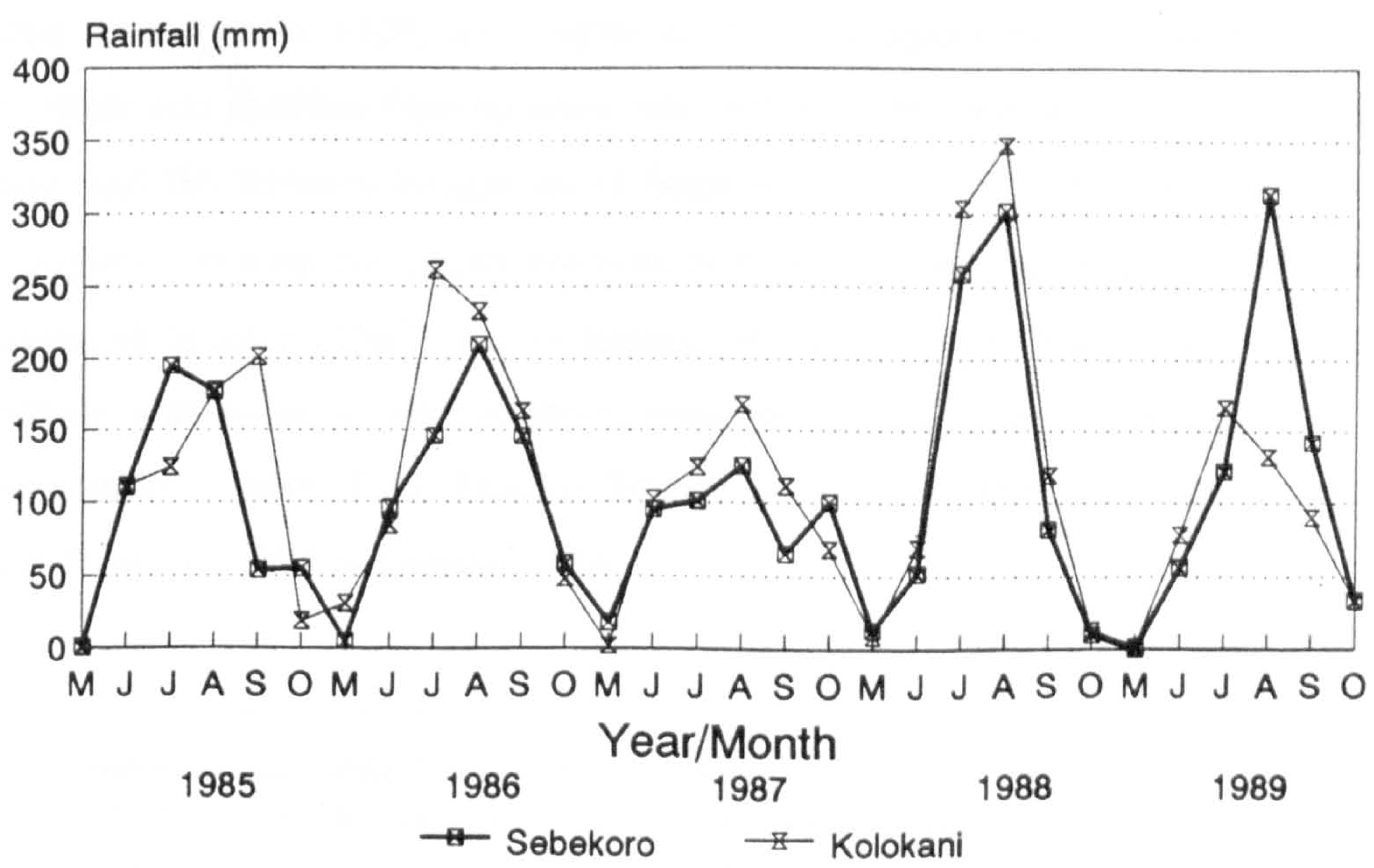


Figure 3.2 Monthly Rainfall in the Cercle de Kolokani from 1985 to 1989



Based on rainfall data from 1933-1980, the *Cercle de Kolokani* receives a mean rainfall of 812.2 mm per annum distributed over a period of 120-150 days (ICRISAT 1984). However, as Figure 3.1 indicates, annual rainfall since 1980 has consistently fallen below this longterm average. Of particular relevance to the present study is annual precipitation from 1987 to 1989. With respect to a mean rainfall of 635 mm for the period 1980-89, precipitation was 10% below the mean in 1987, 26% above the mean in 1988, and 9% below the mean in 1989.

Annual rainfall is concentrated in a single season from July to October, followed by a cool dry season from November to February, and a hot dry season from March to June. However, just as the absolute amount of precipitation received varies substantially from one year to the next, so too does its timing, intensity and duration (Figure 3.2). In a region where dryland agriculture is the predominant mode of production, the timing and intensity of rainfall throughout the growth and development of crops is critical in determining the success of the harvest (Albergel and Grouzis 1985, Glantz 1987)[3].

3.2 Historical, Political and Economic Context

Historically, Mali was a part of number of ancient empires which flourished and declined between the 9th and 19th centuries. Succeeding the Ghana Empire from the 9th to 13th centuries, was the Malinke Empire of Mali, after which Mali is named. The Mali Empire reached its apogee in 1325, later replaced by the Songhay Empire which covered much of Mali, Niger and Burkina Faso between the 14th and 16th centuries. The Fulani Kingdom of Macina, and the Bamana Kingdoms of Segu and Kaarta reigned from the 17th to the early 19th century. In turn, the pagan Empires of Kaarta (1854) and Segu (1861), and the Fulani theocracy of Macina (1862) fell to Islamic jihads led by El Hadj Omar Tall. Subsequent diplomatic and military confrontations with the French over the second half of the 19th century led to demise of the Tukulor Empire of El Hadj Omar Tall, and the creation of the French Sudan in 1892 (Imperato 1986).

---

[3]In assessing the sensitivity of crop yields to rainfall in Burkina Faso, Albergel and Grouzis (1985) found that rainfall accounts for 60% of the variation in cereal yields. In this analysis particular attention is paid to rainfall given its importance in defining both the seasonality of agricultural production, and cropping outcomes.

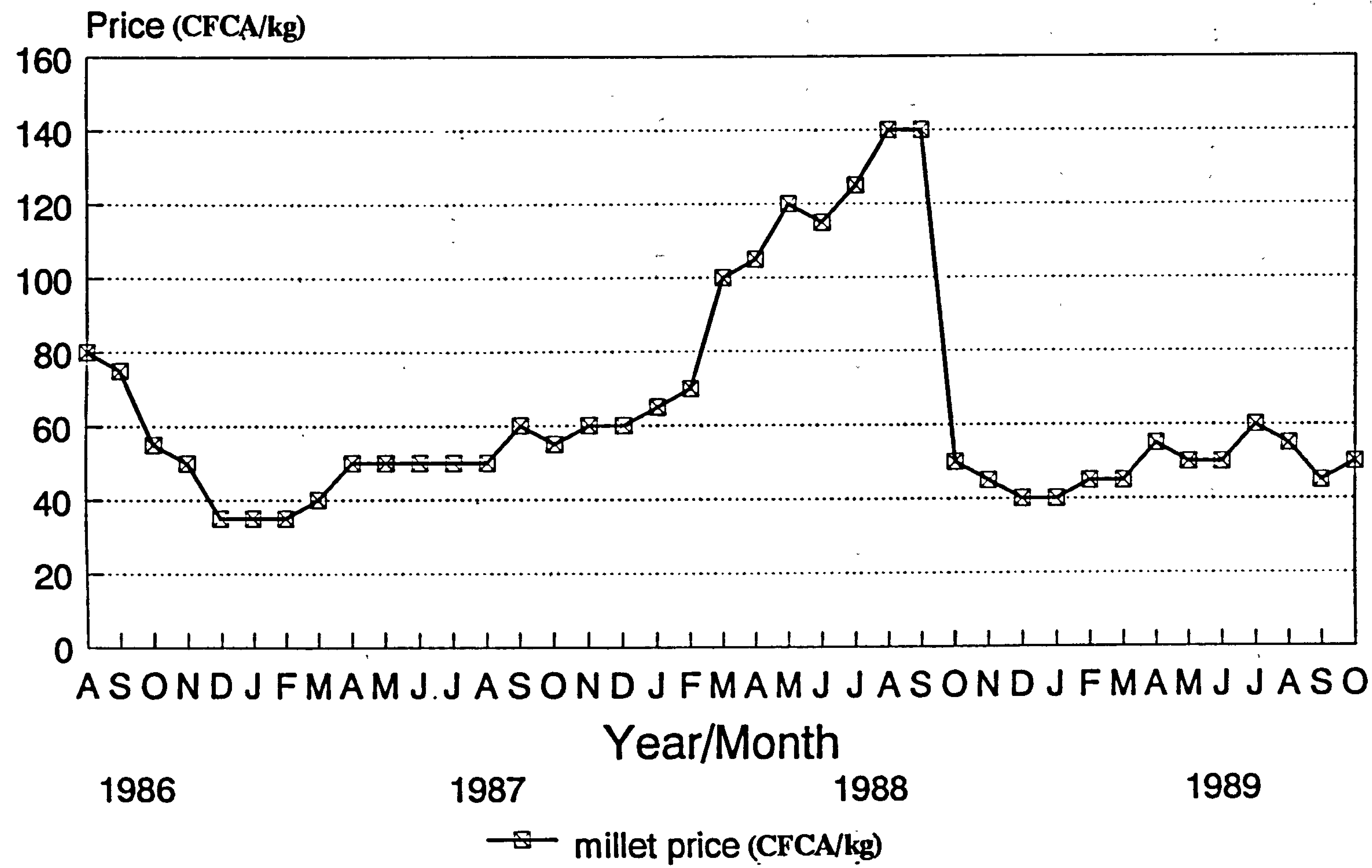
In April 1959, Mali merged with Senegal to form the Federation of Mali which became independent on June 20, 1960. A socialist programme of development was pursued until 1968 when President Modibo Keita was overthrown by the military, and a one-party state was created by Moussa Traore. In 1991, pro-democracy demonstrations culminated in the overthrow of Traore and the establishment of a transitional government to oversee civilian multi-party democracy.

Mali's Gross National Product (GNP) is estimated at US $270 per capita (World Development Report 1991). Agriculture (including forestry and fishing) contributes 50% of Gross Domestic Product (GDP), followed by services (38%), industry (12%), and manufacture (6%). In total, 82% of Mali's population is involved in the agricultural sector (World Development Report 1991).

Although Mali was once self-sufficient in cereals, since the 1970s, food production has faltered due to the combined effects of drought and poor policy (Staatz et. al 1989). A concomitant increase in food imports has occurred in this same period mainly in the form of food aid. Until 1981, the Malian government controlled the cereals market by fixing both consumer and producer prices and by distributing food aid through a state controlled grain marketing agency called the *Office Malièn des Produits Agricoles* (OPAM).

Mounting deficits due to high producer prices after the drought and no proportionate increase in consumer prices resulted in donor pressure to liberalize grain trade and improve operating efficiency (Staatz et al. 1989). Through liberalization, it was presumed that an equilibration of supply and demand would occur. Under the assumption that rural farmers are net sellers of grain, it was surmised that higher producer prices would stimulate growth in agricultural production. The perpetuation of demand and supply uncertainty since liberalization, however, suggests that the vagaries of climate have more bearing on the cereal market than cereals policy *per se*. Not only have private traders failed to respond as anticipated, high cereal prices have imposed heavy costs on low income consumers, which include the large majority of rural agricultural households. Figure 3.3 graphs millet prices in Kolokani from 1986-89 which are almost the inverse of rainfall patterns in the same time period.

Figure 3.3 Monthly Millet Prices in the Cercle de Kolokani from 1986 to 1989



In the wake of the 1984-85 drought, a food security agency called the *Comité Nationale d'Aide aux Victimes de la Sécheresse* (CNAS) and an early warning system (*Système d'Alerte Précoce* (SAP)) were established under the *Ministère de l'Administration Territoriales.* The CNAS coordinates food aid, and centralizes and diffuses information on food emergencies in Mali, while SAP monitors food security indicators (rainfall, crop growth, cereal prices, population movements, food reserves and health). Recent reviews of both programmes indicate problems with monitoring design, data validity, uneven geographical coverage, duplication of effort, and the timeliness of analysis (Koenig 1988:162-5).

3.3 Population, Health and Nutrition

In 1987, Mali's population was estimated at 7,620,225, with a natural growth rate of 2.7% for the period 1982-87 (Mali 1987, provisional results). While the majority of Mali's population are rural, the percentage living in urban areas has increased substantially from 13% in 1965 to 19% in 1989 (World Development Report 1991).

Average life expectancy at birth is 46 years for males and 49 years for females. The infant mortality rate is 167/1000, while the mortality rate for children under-five years of age is estimated at 210/1000 for females, and 239/1000 for males (World Development Report 1991). Adult illiteracy is very high (67% male; 89% female). In 1988, primary school enrolment included only 20% of eligible children (23% boys; 17% girls), while secondary schools drew only 5% of the eligible population (6% boys; 4% girls). Both schools and rural health care services are found in urban centres and *secteur*-level villages which service villages located within a 9-11 km radius. In 1989, there was one physician per 25,390 population for Mali as a whole (World Development Report 1991), and one physician per 73,000 population in the *Cercle de Kolokani.*

Given the paucity of nation-wide surveys of food consumption and nutritional status in Mali, interannual or longterm trends must be surmised using regional and village-level studies[4]. The lack of standardization among existing studies with respect to purpose, sample size, indicators and seasonal timing, however, limits analysis to the general observation that nutritional status varies greatly with region, age-group, ethnicity and season (Levfevre 1988, Sundberg 1988). Since 1980, five anthropometric studies of children have been undertaken in the *Cercle de Kolokani* which indicate that between 5 and 15% of children under five years of age fall below 80% NCHS/WHO/CDS standards for weight-for-height (Levfevre 1988). No studies of adult nutritional status or food consumption have been undertaken in the *Cercle*.

3.4 Ethnography

Mali is comprised of a diversity of ethnic groups which are distinctive in terms of language, culture, history and vocation. Only those groups relevant to the study region are considered in this section (see N'Diaye 1970 for a complete description).

Most numerous in Mali are the Bamana who comprise approximately 35% of the population (Traore 1980). A Mande-speaking people, the Bamana define themselves in terms of their language and their principal vocation as subsistence agriculturalists[5]. Linguistically, culturally and geographically close to the Bamana are other Mande groups, most notably the Malinke, Dyulu, Kakolo, Khasonke, Marka and Sonike (McNaughton 1988). The Bamana are largely found in the central Sudano-sahelian zones of Mali suitable for dryland agriculture: the regions

---

[4]No national surveys of nutritional status or food consumption have been undertaken in Mali, nor have any longitudinal nutritional studies been attempted. Nutritional surveillance has become more systematic as a component of famine relief and early-warning programmes, however, monitoring is largely confined to the 6th and 7th regions where the majority of NGOs operate (Sundberg 1988).

[5]Monteil (1924:7) describes how the Bamana are perceived by others: *"Pour le musulman, le Bambara c'est l'infidèle, le païen, le buveur d'alcool; pour les pasteurs (Maures, Peulhs), le Bambara c'est le cultivateur et aussi le Nègre; pour les Sémites et ceux qui se prétendent tels, le Bambara c'est surtout le Nègre; pour ceux qui ont détenu ou détiennent le pouvoir, le Bambara c'est l'esclave; pour tous c'est le primatif, l'individu socialement inférieur".*

of Segu, Kaarta, Buguni, Sikasso, and the Bèlèdugu. The Bèlèdugu, which spans the *Cercle de Kolokani*, is 80% Bamana[6].

N'Diaye's (1970) etymology of the *Ban-mana*: *Ban* meaning refusal and *mana* meaning master, aptly evokes a history of resistance to Islamic conversion and colonial conquest. Historically, Bamana society was divided into three strata: free men (*hòrònw*), caste groups (*nyamakalaw*) and slaves (*jonw*), a class which has since disappeared (Henry 1910, Monteil 1924, N'Diaye 1970, McNaughton 1988). Bamana society is frequently characterized as egalitarian, with a strong redistributive ideology that has long resisted the penetration of market relations into traditional social and productive organization (Lewis 1979).

The Fulani are the second most populous ethnic group in Mali, comprising approximately 10% of the population (Traore 1980). Fulani society is comprised of two distinct social classes, a noble class of cattle-owning Fulbe, and a non-noble class of mainly agricultural Rimaibe (Hill 1985). While the Rimaibe are largely found in the Niger Delta regions of Segu and Mopti, the transhumant Fulbe are dispersed throughout the Sahel, herding cattle in synergy with the changing seasons. Groups of Fulbe regularly move through the Bèlèdugu in search of water and pasture. Transactions between Fulbe and Bamana are useful to both groups as the Fulbe trade milk for cereal, and the Bamana provide pasture in exchange for animal manure.

The Tamasheq and the Moors are nomadic groups of Berber extraction who roam the Sahara regions of northern Mali. Together they constitute 7% of Mali's population (Traore 1980). In the Bèlèdugu, it is common for Bamana households to host (*jatigi*) Moor families who camp on the village periphery for the duration of the harvest and dry seasons.

---

[6]While the study site was chosen within the confines of the *Cercle de Kolokani*, its local name '*the Bèlèdugu*' is employed throughout the thesis.

3.5 Household Production and Reproduction

a) Semi-subsistence Agriculture

Sorghum (*Sorghum gambicum*) and millet (*Pennisetum typhoides*) represent the principal subsistence crops of the Bèlèdugu region, and Mali in general. Grown during the rainy season from June/July to October, early-ripening varieties (2-3 months) are harvested in late September, and longer-ripening varieties (3-4 months) later in November. Smaller areas are devoted to the cultivation of rice and maize. Mainly confined to irrigated areas in the Niger Delta, rice cultivation is rare in the Bèlèdugu. However, maize is grown throughout the region. Harvested in late September, maize cultivation is an important cropping strategy used to breach the shortage period before the main harvest in November (Chapter VII).

Principal export crops in Mali are cotton and groundnuts, both of which are vulnerable to adverse fluctuations in international commodity prices. In the Bèlèdugu, only groundnuts (*Arachis hypogaea*) are grown. A portion of the annual harvest is sold to pay government taxes and seasonal debts, while the remainder is used for household consumption. Small amounts of red sorrel (*Hibiscus sabdariffa*), okra (*Hibiscus esculentus*), watermelon (*Citrullus lanatus*), cowpea (*Vigna unguiculata*) and bambara groundnut (*Voandzeia subterreanea*) are intercropped with sorghum and millet for household consumption.

Use rights to agricultural lands are inherited by households descended from the individual who first clears it of virgin bush (*kungo*). The village chief (*dugutigi*) allocates land to newcomers, and settles disputes regarding the lending or borrowing of land. If a household splits, usufruct is divided equally between offspring households regardless of household size (Klaus 1976, Lewis 1979).

Like land, the baobab tree (*Adansonia digitata*) belongs to the individual who first plants or prunes it, and is inherited by the compound at large. The mango tree (*Mangifera indica*), on the other hand, is treated as moveable wealth, being inherited by the planter's sons unless the planter functions as household head in which case the trees are inherited by the compound as a whole. The shea-nut tree is also valued in the Bèlèdugu (*Butyrospermum parkii*). Native to the Sudano-sahelian zone, it is allowed to grow in cleared fields when most other trees are cut. The field user has rights to the fruit produced by trees in field areas, while the fruit from trees in bush areas may be claimed by anyone (Lewis 1979: 50-53).

b) Other Productive Activities

In addition to agriculture, the rearing and sale of livestock is an important productive activity in rural Mali. While animal husbandry is secondary to agriculture in most of the Bèlèdugu, it is a particularly vital component of household subsistence in northern Sahelian regions.

Craft production is also common in the Bèlèdugu. While leather, iron and wood-working are the domain of casted specialists throughout the year, many agriculturalists undertake crafts such as mat, rope and basket-making in the dry season. The sale of small commercial goods such as cola-nut, dates and cigarettes is also practised among individuals able to make the necessary capital outlays.

The exploitation of wild produce represents another important income-generating activity. For men, this involves the collection, transport and sale of firewood and grass, while women collect and process shea-nut, locust bean, and physic nut which is used in the manufacture of soap. Market gardening is also undertaken in villages with access to a permanent water supply: tobacco is typically grown by men, while tomatoes, okra, onions, red sorrel (*da*) and wild aubergine (*ngòyò*) are women's crops. Dry season wage-labour migration also represents a critical source of money-income and cereal in Bèlèdugu households.

c) Seasonal Calendar

As Table 3.0 summarizes, in the Bèlèdugu productive and social activities are defined in relation to the seasons[7]. Agricultural work commences as early as May with the clearing (*waa bò*) and cultivation of farm lands. With the arrival of the *banikònò* (*Ciconia abdimii*), a stork said to presage the rainy season, the rhythm of cultivation increases in preparation for sowing (*danni kè*).

Table 3.0 Seasonal Calendar of Activities in the Bèlèdugu, Mali 1988-89

season	month	agricultural	non-agricultural	social
RAINY	Jun	plough, cultivate and seed	gather honey; process soumbala	dry season migrants return
	Jul	plough, cultivate and seed	gather shea-nut	*Tabaski* (Muslim festival)
	Aug	1st weed	gather shea and physic nuts	*cibò* work groups
	Sep	2nd weed; harvest maize, okra and early-ripening varieties	process shea-nut butter; make soap	Fulbe take livestock
HARVEST	Oct	harvest baobab leaves; plant vegetable gardens; guard fields	make rope and baskets; process shea-nut butter	dry season migrants leave; community work
	Nov	harvest groundnuts, millet, sorghum, squash, red sorrel and cowpea; garden		
	Dec	thresh house field crops (*soforo*); garden		harvest work groups; Moors arrive
	Jan	thresh main field crops; (*forobaforo*); transport, winnow and store crops	make calabashes and soap; collect millet straw and grass; market activity	harvest work groups; alms and gift-giving; Fulbe return livestock
DRY	Feb	compost spreading in house fields; garden	make bricks; gather wood; spin and weave cotton; market activity; livestock	host religious visitors; tax collection
	Mar		house repair and construction; spin and weave cotton; hunt; livestock	neighbourhood work groups; host visitors; ceremonies
	Apr		house repair and construction; spin and weave cotton; hunt; livestock	Ramadan (Muslim fast); ceremonies
	May	burn and clear fields harvest mangos	house repair and construction; spin and weave cotton; livestock	Moors depart; ceremonies

During the initial rains of the season, all household labour is harnessed to sow the crops as quickly as possible to ensure a growing season of optimal length. However, as was the case in 1989, late or poorly distributed rainfall frequently necessitates reseeding a second or third time. In this period, agriculture takes precedence over all other productive activities. Indeed,

[7]The Bamana calendar is comprised of least six seasons which correspond to changes in climate, and agricultural activity: *samiya* or the wet season (Jun-Sep); *kawula*, a humid post-*samiya* period; *fabonda* (Oct-Dec); *fonènè* or the cold season (Dec-Feb); *tilema*, a dry hot season (Mar-Mid-May); and *sankunanji*, a humid pre-*samiya* season (May). For the purposes of this thesis, the Bamana calendar is collapsed into three seasons: harvest (*fabonda and fonènè*), dry (*tilema*) and rainy (*samiya*).

many farmers hire Fulbe herders to pasture livestock in the bush for the duration of the rainy season to facilitate agricultural work. Even the gathering of wild fruits such as shea-nut (*Butyrospermum parkii*) and physic nut (*Jatropha curcas*) takes place before dawn and the commencement of daily agricultural labour[8].

In early August, the first weeding commences (*sènè kè*), with remunerated communal work groups (*cibò)* circulating among household fields according to a calendar established at the onset of the agricultural season. The second weeding occurs in September, after which the rhythm of agriculture slows considerably. Maize, okra and early-ripening millet (*suna*) are harvested in late September to provide an interim supply of cereal until the main harvest.

October represents a month of waiting. The surveillance of fields against pests and crafts occupy men, while women participate in work groups to process (*kòlòn susu*) physic nut soap (*muguni*) and shea-nut butter (*situlu*). In November, the harvest of crops planted in house fields (*soforow*) on the village periphery occurs, while the harvest of main fields (*forobaforow*) of millet, sorghum, and groundnuts follows in December.

Threshing (*gèsi*) commences in late December and continues into January as communal labour groups visit participating households in turn. The harvest is winnowed by women, transported to the village, stored in the household granary or sold at the local market. In the same period, tax collection and rainy season debt repayment necessitate the sale of groundnuts, and in more extreme circumstances, the sale of subsistence crops to acquire needed cash. The final clearing of millet stalks to create shelters for the dry season, and the transport of village compost to surrounding *soforow*, signal the end of the agricultural season.

Given the intense heat of the dry season months of February, March and April, work is restricted to the cooler morning hours and the late afternoon until dusk. Men are mainly involved with livestock, crafts, and the repair and construction of village dwellings. Informal

---

[8]The household labour force leaves for the fields at dawn. Agricultural work is continuous throughout the day with a brief pause for the mid-day meal (11:30-12:00). Women responsible for meal preparation and its delivery to the field cultivate until 3:00 pm before returning to the village to begin pounding millet for the evening meal. Habitually, household workers make their way home between 6:30 and 7:30 pm, bathe, eat and retire to bed.

groupings of neighbours and kin often cooperate in this task. During the *heures mortes* of mid-afternoon, men recline and socialize under the shade of the village *miradour* (a communal meeting place). On occasion, groups of men undertake collective hunting expeditions (*fèlèbow*) in search of wild fowl (*Francolinus bicalcaratus, Numida meleagris*) which take cover under bush foliage during the afternoon heat of the dry season[9].

In addition to their normal domestic responsibilities, women collect firewood in the dry season period, card and spin cotton and engage in market activities such as the manufacture and sale of traditional spices (*soumbala, datu*), dry couscous, or prepared foods. Social activities such as marriages, initiations and circumcisions which mainly occur in the dry season, draw to a close when bush-burning and other land-clearing activities are initiated in preparation for the rainy season.

Population movements also reflect the changing seasons as they define productive and social activity. During the clearing and cultivation period in June, migrants return for the agricultural season, and leave prior to the harvest in October. In December, transhumant Moors settle on the outskirts of host households in the village to assist with the harvest. They remain through the dry season and depart northwards with the rains. The dry season is marked by a constant flux of people into and out of the village. Indeed, some households disperse altogether in the dry season months only to be reconstituted when agricultural work recommences. Accompanying the outflow of dry season migrants and women visiting their natal villages, is an inflow of visiting marabouts, praise-singers, musicians, blacksmiths and extended kin. Population movements generally wane after the month of Ramadan. ?

d) Household Organization

Patrilineal and patriarchal in organization, the productive and reproductive functions of the Bamana household are adjudicated by the eldest male member (*dutigi*). Under the management of the *dutigi*, household members cooperate in the cultivation of a communal

[9] A group of about twenty men and young boys range the savanna with large sticks which they use to beat the bush. The stunned bird emerges and is pursued with great energy until it is successfully trapped by the group.

field (*forobaforo*), the produce of which is collectively owned. The *dutigi*, however, has ultimate authority over all compound-level goods, including land, labour, production, tools and other property and use rights (Klaus 1976). Responsible for household subsistence, the *dutigi* is invested with the power to determine the daily millet ration, and the amount of cash crop grown and sold to cover agricultural inputs, government taxes and brideprice payments (*furanafolo*). It is also through the *dutigi* that household members may apply for land and time away from the *forobaforo* to cultivate personal fields (*jònforow*)

Household structure among the Bamana may be simple, composed of a man and his immediate family (60% of Bèlèdugu households), or complex (40% of Bèlèdugu households), a paternal association consisting of a household head and his married sons and their families, or a fraternal grouping of married brothers and their families. Also part of the household are non-lineage members which may include foster children, herders, visitors and hired labourers (*baaradenw*) who have established a long or short-term association with the household (Becker 1989).

Household production and reproduction is organized with respect to gender and generational principles. Young boys begin assisting on the *forobaforo* at an early age (10-13 years). Adolescent boys and unmarried men also cultivate the *forobaforo*, and the *jònforow* of their mother, father or fraternal brother, having limited claim to land and labour themselves. Married men, on the other hand, may request land from the *dutigi* for the cultivation of *jònforow* on designated days of the week.

Until marriage, young girls are largely excused from arduous agricultural work. However, with marriage, women must submit to the authority of their husbands, cultivating both the *forobaforo* of the greater household and the *jònforow* of their spouse. In addition to agricultural work, married women are responsible for the domestic tasks of water and fuel gathering, condiment procurement, cereal processing, meal preparation and child care. Although a limited number of younger married women cultivate *jònforow* of their own, it is only with the menopause and/or the marriage of their eldest son that women are released from the *forobaforo* and permitted to cultivate on their own.

However, it should not be infered that productive and reproductive relations within the household are necessarily complementary and harmonious. Conflict also defines the Bamana household (Becker 1989); the young strive for independence, and the old for control; tensions generating from polygamous marriage strain relations between co-wives and half-brothers; and the separate economic and social spheres of men and women collide on matters of mutual interest.

3.6 Study Village Description

Divided into five *arrondissements*, the *Cercle de Kolokani* is located in the larger administrative *region* of Kulukoro, 130 kilometres north of Bamako (see Figure 3.0). In 1987, its population was estimated at 149,959 inhabitants (72,371 male; 77,588 female) found in approximately 280 villages ranging in size from rural hamlets of 15 inhabitants, to the administrative centre, Kolokani, with a population of 11,943 (Mali 1985). Considered a region of surplus production based on aggregate production figures (Sundberg 1988), government food security stocks are are only sporadically reinforced and distributed (SAP Bulletins 1987 to 1989).

The *Cercle de Kolokani*, traditionally known as the Bèlèdugu, was settled long before colonial penetration. Indeed, some villages in the region date back to the empires of Segu and Kaarta in the 18th and 19th centuries, their ancestors having fled from these regions to escape Islamic conversion. The Bèlèdugu is predominantly Bamana in ethnicity, with a small representation of Kakolo, Sonike and other sedentary agricultural groups. Fulbe and Moor pastoralists roam in northern Sahelian regions; many moving southward during the harvest and dry seasons in search of better pasture.

As shown in Figure 3.4, the 7 sample villages are spread throughout the Bèlèdugu region. By way of introduction, this section provides a brief description of the location and distinguishing characteristics of each village in turn. Table 3.1 orients this discussion by providing a summary of household demographic features according to village (see Appendix V for variable descriptions).

Figure 3.4 Map of the Cercle de Kolokani Indicating Village Sample Sites

Table 3.1 Household Demographic Characteristics in 7 Cross-sectional Villages, Bèlèdugu, Mali: mean (sd)						
village	wealth index	hhold size	dependency ratio	% complex hholds	kin location index	% loss to migration
Kossumale	44 (29.5)	14 (8.3)	1.7 (0.27)	55	1.0 (0.74)	1.8
Sèbèkoro	25 (24.0)	14 (10.2)	1.9 (0.57)	40	0.7 (0.73)	11.0
Falakan	25 (26.4)	12 (7.6)	1.8 (0.37)	30	1.1 (0.48)	4.7
Dubala	20 (21.6)	11 (7.3)	1.8 (0.42)	20	0.8 (0.56)	8.0
Bala	32 (26.9)	17 (16.1)	1.7 (0.24)	25	1.6 (1.10)	8.0
Fonfilèbugu	37 (22.7)	10 (2.3)	1.9 (0.26)	30	1.4 (0.97)	5.0
Zambugu	29 (25.6)	16 (10.3)	1.8 (0.28)	70	1.4 (0.83)	0.6
all	30 (25.8)	13 (9.8)	1.8 (0.29)	40	1.1 (0.85)	5.6
ANOVA[1]	N/S	N/S	N/S	*	***	N/A

[1] Oneway analysis of variance between villages: N/S not significant N/A not available
** p<0.01 *** p<0.001

a) Kossumale

Located 25 kilometres from the commercial centre of Kolokani, Kossumale was founded in the late 18th century by the Kulibaly lineage. Little seasonal migration is reported in the village, rather, productive activities mainly centre on agriculture and animal husbandry. Agricultural implements are possessed by most households due to a recent credit programme offered through ODIPAC (*Opération de Developpement Integré pour la Production Arachidaire et Cerealière*) for the purchase of farming materials. This accounts for the high wealth index in Kossumale relative to the other sample villages. Women participate in agriculture and cultivate small gardens for home consumption. A strong ethic of interhousehold cooperation exists in the village indicated by the existence of male and female work associations and the cultivation of a communal field, the proceeds of which are used to defray village expenses. Kossumale possesses no social infrastructure; the nearest market, school, and health centre are located 8-9 km away in the villages of Fassa and Djiwoyo.

b) Sèbèkoro

Site of both the cross-sectional and longitudinal studies, Sèbèkoro is located 10 km west from the Baole river, and 45 km east of Kolokani. It was founded in the mid 19th century by the Kakolo lineage 'Fofana' who had fled across the Baole river from Kaarta at the time of the Islamic jihad against the animists led by El Hadj Omar Tall. Since, it has become the *secteur* level administrative centre for the *arrondissement* of Kolokani. As such, Sèbèkoro is well-equipped with a maternity/health clinic, agricultural extension office, primary/secondary school and weekly market. Figure 3.5 indicates the location of Sèbèkoro with respect to other villages in the environs.

Locally, Sèbèkoro represents the centre of the *Kakolola* region of the Bèlèdugu. However, through the Kakolo's coexistence with the Bamana of the Bèlèdugu, an inevitable blending of culture and language has occurred. Comprised of four ethnic groups, the first group includes eleven Kakolo households whose forbearers come from Kaarta. Five households of Bamana descent (four of Kaarta origins) form the second group. The third contains ten households of Bamana ethnicity who have recently settled in the village, while seven households of mixed ethnic origin (two of Malinke, two of Sarakole and one of Fulbe descent), constitute the fourth group. With the exception of two well-established households, members in the fourth group have recently joined the village, attracted by the commercial opportunities offered by the weekly market. A conspicuous loss of young men to migration has occured since the drought of 1984-85.

As Figure 3.6 indicates, the spatial organization of Sèbèkoro village reflects its social evolution over time. Long-established Fofana and Traore lineages have compounds near the spreading tree which marks the centre of the village (*fèrè*). Surrounding them are the compounds of more recently settled households and government public servants and their families, all of whom are considered 'strangers' to the village. Finally, on the periphery of the village are the tents of transhumant Moors in the harvest and dry seasons.

Figure 3.5 Map of Sèbèkoro and Environs

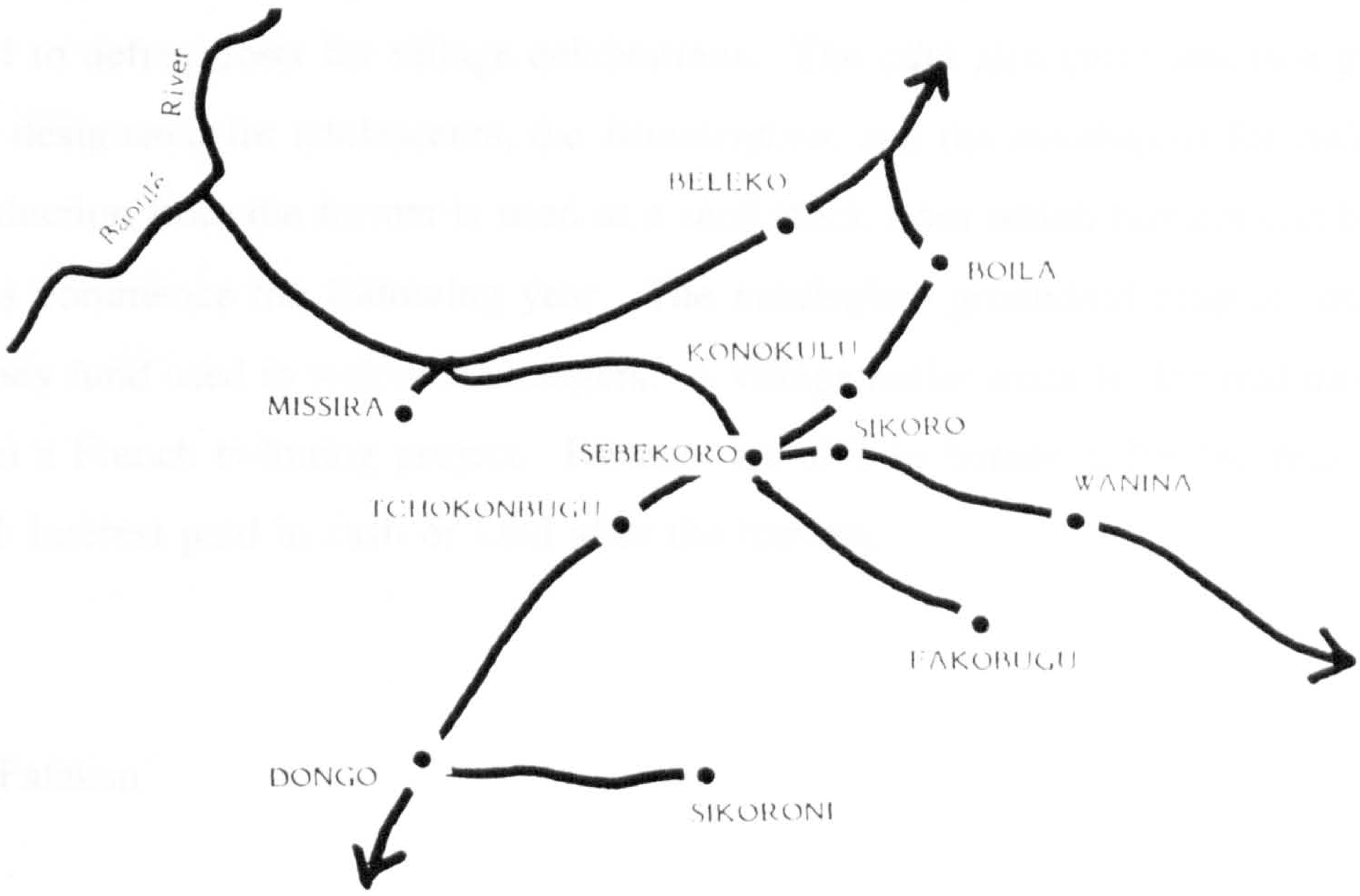
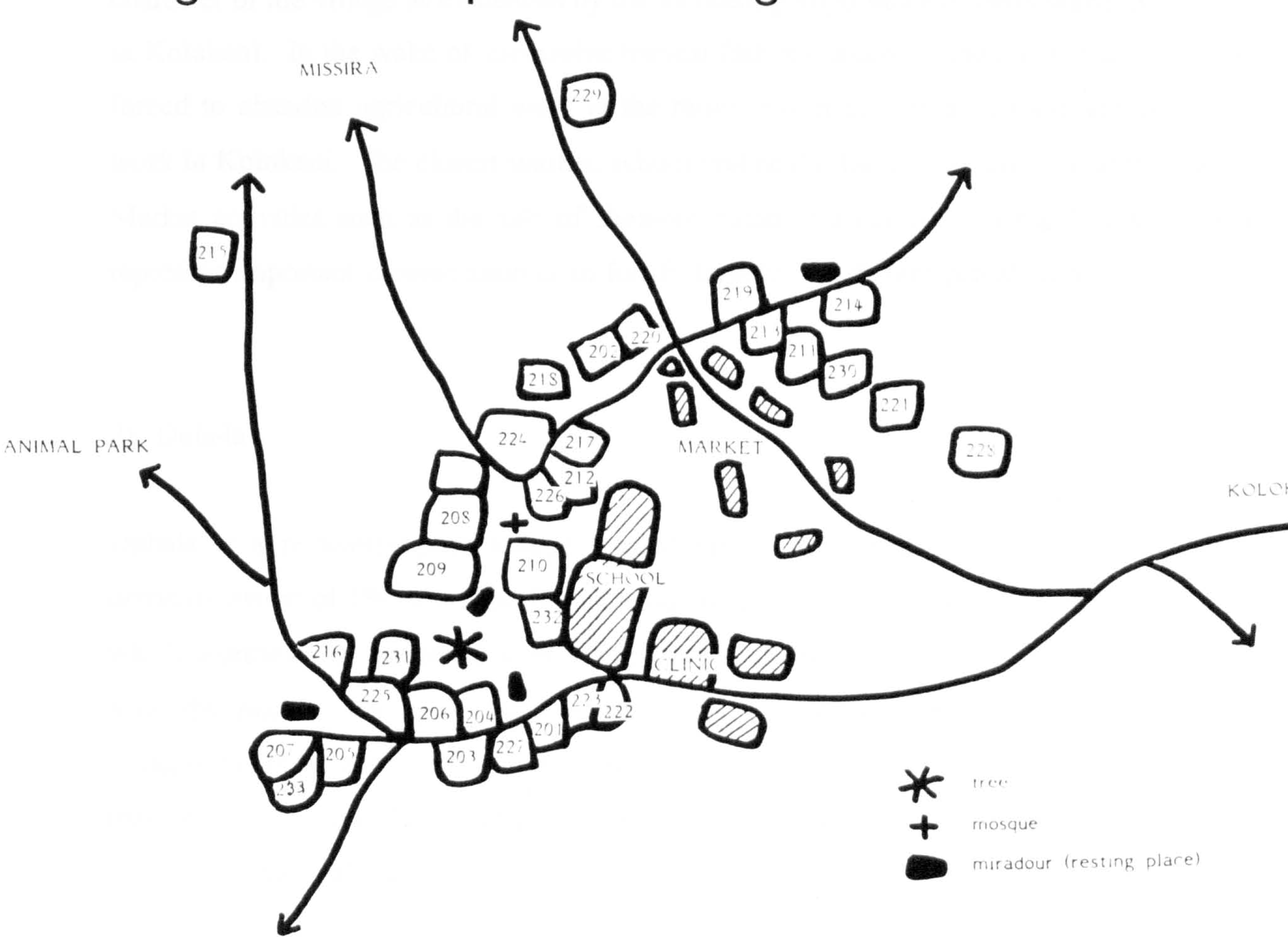


Figure 3.6 Map of the Village of Sèbèkoro



Sèbèkoro possesses a formal labour group (*cibò*) composed of able-bodied men aged 13 to 35. On Wednesdays, this group circulates between households according to a schedule established at the beginning of the agricultural season. Operating during cultivation and weeding periods, a day of labour costs 5000 CFCA payable after the harvest. Proceeds are used to defray costs for village celebrations. The *cibò* also cultivates two groundnut fields, one designated for adolescents, the *kamalenforo*, and the *maabaforo* for older married men. Production from the former is used as a seed stock from which farmers can borrow when the rains commence the following year. The *maabaforo* groundnut crop is sold to replenish a money fund used to welcome strangers. A village millet stock is also maintained using funds from a French twinning project. Farmers are able to borrow a limited quantity of cereal at 10% interest paid in cash or kind after the harvest.

c) Falakan

Falakan's proximity to Kolokani (8 km away) greatly influences the social and economic character of the village as evidenced by the increasing importance of daily wage-labour found in Kolokani. In the wake of successive harvest failures, many women in Falakan have been forced to abandon agricultural work in the rainy season in search of food and/or domestic work in Kolokani. The closest market, school and health facility are also found in Kolokani. Market activities such as the sale of shea-nut butter and firewood at the Kolokani market represent important income sources to fortify largely insufficient cereal stores.

d) Dubala

Dubala is a relatively poor village located on the fringes of the Sahel in the northern *arrondissement* of Didieni. The flora surrounding Dubala is dominated by the Raphia palm which represents an important wild food source in the soudure period. Given the absence of a nearby market, strong networks of credit and labour between Dubala and surrounding villages facilitate access to cereal in the soudure season. The productive efforts of men mainly concern agriculture and pastoralism supplemented by small amounts of income from dry season mat-making and market-gardening. Women in Dubala appear to have little social or economic independence relative to other Bèlèdugu villages; working exclusively for their husbands, few engage in any private cultivation or income generation. While Dubala possesses a primary school and health centre, both operate only intermittently.

e) Bala

The village of Bala is located in fertile lowland 6 km west of Didieni. Settled in the late 18th century, Bala is mainly populated by descendants of the founding Diarra lineage. The traditional extended family is very strong in Bala as indicated by a mean household size of 17 members, a kin location of 1.6 and the existance of communal networks of exchange. Village households cooperate in the cultivation of a communal field, the produce of which functions as a cereal bank for needy households. A *cibò* work group is active in the village, providing paid labour during bottleneck periods of seeding and weeding. Bala's close proximity to Didieni provides a market for craft production, however, water shortage has curtailed the market-gardening activities of women. Bala's proximity to *arrondissement* headquarters in Didieni has also facilitated the regular receipt of NGO food aid.

f) Fonfilèbugu

Fonfilèbugu is known to be one of the most fiercely traditional of Bamana villages in the Bèlèdugu. Indeed, it has successfully resisted the penetration of Islam as evidenced by the proliferation of animist secret societies in the village. The tenacious preservation of traditional values is also manifested in the emphasis on subsistence agriculture over other productive activities. Relatively little migration occurs and women are permitted little economic independence. A village youth group farms a field of millet, the harvest of which is lent to households short of cereal in the soudure period. Although there is no formal health centre in Fonfilèbugu, a number of villagers have received basic training in primary care and midwifery. The closest health centre and primary school are 8 km away in the village of Sebu.

g) Zambugu

Zambugu is located on the main Kolokani-Bamako road in the southern most *arrondissement* of Nussombugu. Since its settlement by the Diarra lineage in the late 18th century, the village has differentiated into four wards which are distinct in terms of geographical space, soil fertility and wealth (Chapter VII). Zambugu's proximity to the weekly markets of Ouolodo and Nussombugu and a seasonal river facilitate the market-gardening of tobacco, guava, tomatoes and onions. The abundance of shea-nut trees in the area also provide an important revenue source for women. Health facilities and schools are located in the nearby centre of Nussombugu.

CHAPTER IV: SEASONAL FOOD INSECURITY AND NUTRITIONAL RISK

4.0 Introduction

As it is most commonly understood, 'nutritional risk' refers to the chance or probability of hunger, poor growth, ill health or mortality due to an insufficiency of food (McLean 1984:10). As applied to the field of nutrition, the risk approach usually concerns the identification of physiological parameters which are predictive of nutritional and related consequences (McLean 1984:15-16). By locating those at greatest risk, and analyzing the mechanisms whereby risk is created and sustained, 'at-risk' groups are identified and strategies designed to alter or influence the determinants of that risk.

This chapter examines the impact of seasonal food insecurity on nutritional risk in the village of Sèbèkoro. Investigating seasonal variations in anthropometric indicators of nutritional status, it explores the hypothesis that seasonal nutritional risk is experienced differentially by age and gender groups within the study population. This chapter also provides an empirical basis for testing the hypothesis that the human organism is capable of adjusting to seasonal variation in nutritional risk without apparent adverse consequence. These themes are developed further in Chapter V which considers the determinants of seasonal nutritional risk and its likely functional implications.

By way of introduction, Section 4.1 considers the concept of nutritional risk and its measurement. Following this, select indicators of nutritional risk are used to assess the relative impact of seasonality on various age and gender groups in the study population. In Sections 4.2 to 4.4, children under five years of age, children aged 10 to 15 years, and male and female adult samples are assessed in turn. Throughout the chapter, repeated measures analysis of variance is used to analyze the statistical significance of seasonal variation (see Chapter II for a description).

4.1 Nutritional Risk and its Measurement

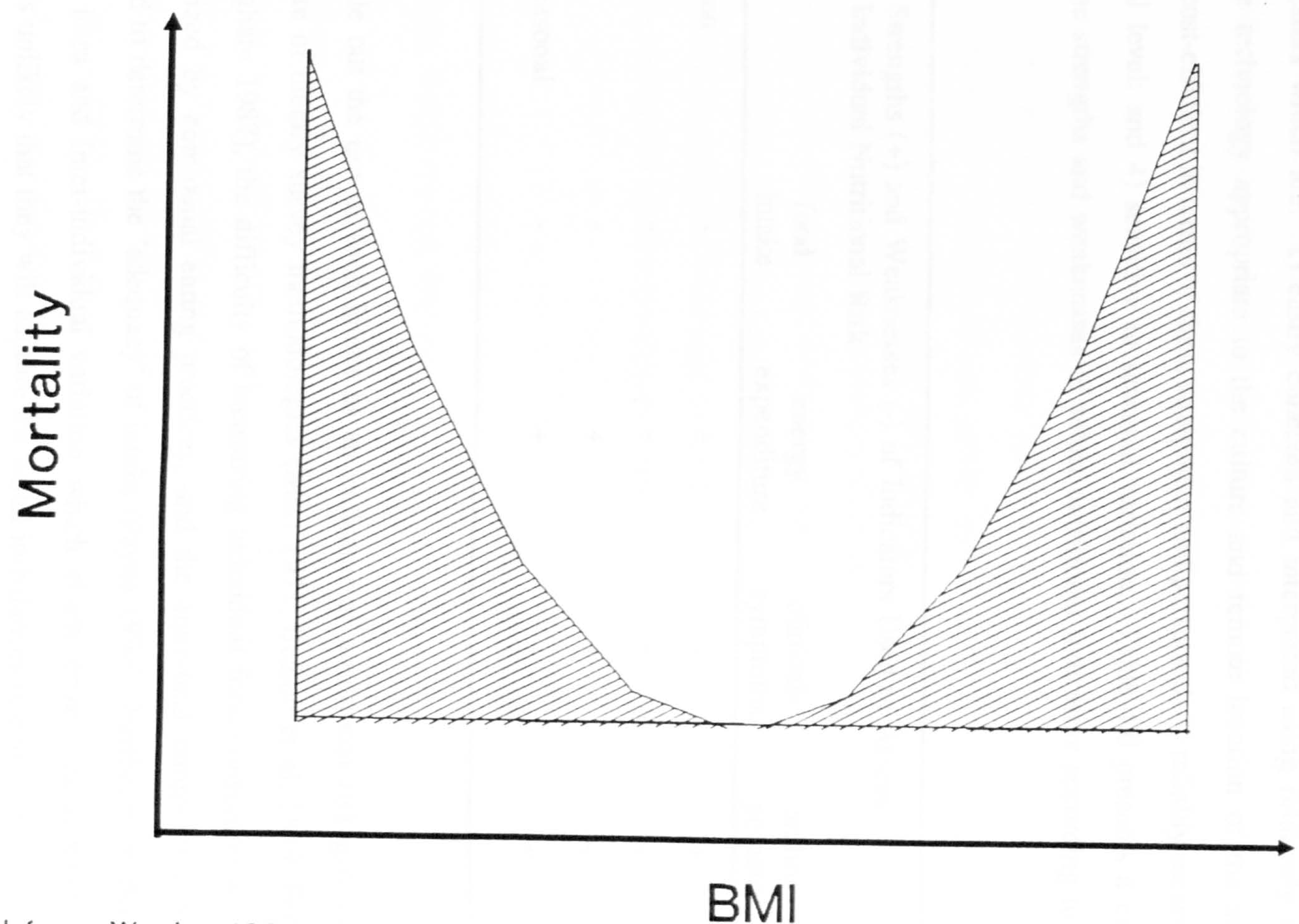
An examination of the risks associated with inadequate food intake yields a varied spectrum of undesirable outcomes ranging from the probability of complete dysfunction as indicated by severe nutrient deficiencies, illness or mortality, to less than acceptable achievement in terms of the diversity of nutrient intake, productivity or attained body size (McLean 1984:17). The particular definition of adverse outcome that is employed depends on the characteristics of the environment concerned, resource availability and overall purpose. For example, the undesirable outcome in a famine situation may be total dysfunction, or mortality. Hence, limited resources are channelled to identifying those at greatest risk of dying. In a peri-urban nutritional surveillance programme, less than acceptable growth may represent the outcome variable which orients nutritional efforts toward identifying those children small for their age.

Perceptions of risk may also vary depending on the particular nutritional paradigm that is adopted (Payne 1985). According to the genetic potential view, any individual failing to attain an 'optimal' state of nutritional health is potentially at risk. In regarding the individual as capable of adapting to a range of diets and environments without adverse functional consequence, the adaptability perspective has a more selective view of risk limited to individuals pushed beyond the limits of their adaptability range (Payne 1985a:166-120).

Indicators used to assess nutritional risk vary in type, sensitivity and specificity. Indeed, the use of different indicators or different cut-off points within and between indicators will result in a variety of risk definitions often providing very disparate estimates of individuals 'at-risk' (Pacey and Payne 1985:40-48).

The strength of association between adverse outcome and a given indicator is the basis of risk prediction. A risk curve function, which traces the outcome effect for various levels of a given indicator, is developed to facilitate the prediction of risk using the 'state' indicator alone (McLean 1984:19). Figure 4.0, for example, describes the risk curve function between mortality, the outcome variable, and adult Body Mass Index (BMI), the 'state' variable.

Figure 4.0 A Risk Curve Function: Mortality risk according to BMI (wt/ht*ht)



Adapted from Waaler 1984:26

While indicators are chosen for their ability to predict outcome, the risk curve function may be influenced by extrinsic variables such as environment, local disease patterns or genetic variation.

In order to identify age and gender groups at greatest seasonal risk, the study requires nutritional indicators which are: 1) easily collected and interpreted using relatively non-invasive, simple technology appropriate to the culture and remote location of the study population; 2) cost-efficient in terms of time, equipment and personnel; 3) reliably measured at the individual level; and 4) sensitive to seasonal variation. Table 4.0 presents a crude assessment of the strengths and weaknesses of select nutritional indicators according to the above criteria.

Table 4.0 Strengths (+) and Weaknesses (-) of Indicators Used to Assess Individual Nutritional Risk

criteria	food intake	energy expenditure	clinical-symptoms	anthro-pometry
ease of collection	-	-	-	+
cost-efficiency	-	-	-	+
reliability	-	+	+	+
sensitivity to seasonal variation	-	+	+	+

These criteria rule out the use of food intake as an indicator of nutritional risk given the problematic nature of dietary survey methodologies (Marr 1971, Beaton et al. 1979, Ferro-Luzzi 1984, Bingham 1987), the difficulty of measuring individual food consumption in a society characterized by communal eating practices, and the equivocal nature of energy requirements used to determine the 'adequacy' of intake (Payne 1990). Furthermore, due to the considerable intra and inter-individual variation which characterize measurements of energy intake, it is unlikely that they will capture the small imbalances in energy equilibrium which are the basis of seasonal fluctuations in body energy stores (Ferro-Luzzi 1984:89)[1].

[1]Although the study measures **household level** food consumption in Chapter V, it does so with the explicit purpose of understanding the determinants of nutritional risk as measured by anthropometry.

Many of these same criticisms apply to the use of energy expenditure as an indicator of nutritional risk. Not only is the measurement of energy expenditure complicated by intra and inter-individual variability, to be interpreted as an indicator of nutritional risk it must be accompanied by some estimate of energy intake. Although the reliability of this indicator may be increased using costly and technically demanding techniques such as indirect calorimetry, so too is the invasiveness of its measurement. Likewise, the invasiveness, cost, technical equipment and expertise required to measure and use clinical criteria as outcome indicators of nutritional risk is beyond the capacity of the present field study.

Anthropometric indicators are preferred given their relative ease of measurement and interpretation, and the existence of a growing literature linking them to morbidity and mortality risk. Expressed as a function of age, gender and/or time, physical characteristics such as weight, height, arm circumference, and skinfold thickness are measured and transformed into conventional anthropometric indices which include weight-for-height, height-for-age, weight-for-age, growth velocity, body mass index, percentage body fat and arm muscle area. These indicators are commonly interpreted in relation to mean reference values established for a healthy population which are assumed to represent a 'normative' standard. Nutritional risk is assessed in relation to subjective 'cut-off' points set below this population norm.

a) Weight-for-height, Height-for-age, Weight-for-age and Growth Velocity

The nutritional assessment of Sèbèkoro children employs the anthropometric indicators weight-for-height, height-for-age, weight-for-age and growth velocity. Particular emphasis is given to weight-for-height due to its sensitivity to acute episodes of disease and malnutrition (Gibson 1990). Height-for-age provides a measure of past episodes of illness or nutritional deprivation while weight-for-age combines the effect of past and present episodes. Seasonal weight (kg/year) and height (cm/year) velocities are also derived to provide a dynamic measurement of growth over time.

The indicators weight-for-height, height-for-age, and weight-for-age are expressed in terms of 'z-scores' or standard deviations from the median of NCHS/CDC reference curves given the superiority of this technique over percentage of median and percentile methods. Not only does it take into account the variability in dispersion of different indicators over different age groups, the 'z-score' method facilitates the assessment of nutritional status over time for a relatively large age range, and provides a common unit for within sample comparisons[2].

These indicators are measured monthly in order to capture fluctuations which may be linked to seasonal perturbations in food availability, and/or morbidity. Of particular concern in the literature are seasonal fluctuations in anthropometric indices below -2 standard deviations (sd), which indicates moderate or second degree protein energy malnutrition (PEM). While limited in number, most published studies note a strong predictive relationship between impaired growth and increased mortality risk, although the slope and threshold effects of this relationship differ greatly with environment, other nutritional deficiencies, the availability of health services, levels of child care, etc. (Heywood 1986, Garenne et al. 1987, Chen et al. 1980).

A relationship between growth faltering, immune response and risk of morbidity is also documented in the empirical literature (Sinha and Bany 1976, Kielmann et al. 1976, Tomkins et al. 1989). In particular, there appears to be a greater risk of cellular immune dysfunction with poor growth, manifested by an increase in the duration of morbidity episodes such as diarrhoea. The majority of studies agree that these effects are most pronounced in the case of children falling below -3 sd of NCHS/CDC reference curves.

It remains, however, that anthropometric measures of growth are proxy, or non-specific, indicators of nutritional status. Also sensitive to a number of other environmental, social, and economic conditions such as disease and access to health care, as well as genetic determinants, anthropometric measurements cannot be regarded as the outcome of dietary deficiency alone (WHO 1990). Nor is it clear at what point small deviations from a mean reference curve will cease to be normal and self-restoring, and without functional consequence (Payne 1990).

---

[2]The 'z-score' method also overcomes a weakness of the original NCHS/CDC data set restricted to observations between the 5th and 95th percentiles for weight-for-height, height-for-age and weight-for-age indicators. To calculate 'z-scores', NCHS/CDC reference data was transformed into normalized curves which facilitate extrapolation beyond these outer percentiles (Dibley et al. 1987).

b) Body Mass Index

In the case of adults and older children (aged 5+), seasonal change in nutritional status is assessed using Body Mass Index (BMI=weight/height^2 (kg/m^2)), an indicator of size or 'fatness' which is more independent of stature than other weight and height indices (Norgan 1990:79). The association between BMI and mortality risk among adults has been extensively investigated in affluent societies. Both life insurance companies and prospective studies of non-insured populations confirm that the range 20-25 kg/m^2 is associated with minimum mortality risk (Society of Actuaries 1979, Waaler 1984, Garrow 1983). Above this range, mortality risk increases quite slowly at first, and then more rapidly as BMI exceeds 30 kg/m^2, and mortality from diabetes, digestive, cerebrovascular, and coronary heart diseases becomes more widespread (Garrow 1983:705). While less investigated, the rise in mortality risk occurring when BMI falls below this range is most probably the result of lifestyle characteristics such as smoking and alcoholism, as well as psychological disturbance and chronic illness (Garrow 1981). Recent literature suggests that a BMI of 12-13 is the lower limit compatible with human survival (Henry 1990).

Unlike more affluent societies where normal BMI lies between 22-27 kg/m^2 (Waaler 1984), among populations in the developing world mean BMI is reported to range from 19-21 kg/m^2 (Tanner and Eveleth 1990). Unfortunately, however, no systematic investigations of the relationship between BMI and mortality risk have been undertaken in the developing countries (James et. al 1988).

In the absence of prospective data, James et al. (1988) use BMI to diagnose Chronic Energy Deficiency (CED), a low but 'steady' state of energy balance associated with an increased risk to health and function. They suggest a graded classification with an upper limit of 18.5 above which BMI is considered compatible with health and function.

A diagnosis of grades I and II CED depends on finding a combination of a BMI of 17-18.4 or 16-16.9 kg/m^2 with a ratio of energy turnover to predicted BMR of less that 1.4[3]. BMI below this range is classified as Grade III CED, a state of energy balance which is considered incompatible with both health and function. The seasonal analysis of adult BMI will refer to this graded classification in the absence of mortality risk curves based on BMI in developing countries.

c) Body Composition

To further investigate the impact of seasonal fluctuations in body composition on nutritional risk, further measurements are necessary to isolate lean and fat tissues compartments that are undifferentiated in the measurement of BMI. Depletion of the body's lean tissue mass is likely to have more serious repercussions for work-capacity and health than the loss of fat tissue. Indeed, only 11% of body fat is considered essential to body structure, the remainder representing a reserve which may be drawn upon in times of need (Passmore and Eastwood 1986:8).

For the adult population (age 16+), percentage body fat is measured using Durnin's equation which predicts body density using the logarithm of the sum of four skinfolds (Durnin and Womersley 1974)[4]. Given evidence suggesting racial differences in fat patterning, some authors have questioned the applicability of generalized skinfold equations developed on white adults from western populations, to rural African populations (Cronk and Roche 1982). However, a recent study on black Americans designed to test the accuracy of skinfold

[3]In order to substantiate the diagnosis of CED based on BMI alone, James et al. (1988) recommend that the physical activity level (PAL) of the individual be calculated based on the indirect measurement of energy expenditure expressed as a ratio of predicted BMR (FAO/WHO/UNU:1985). In this way, false positive diagnoses of CED can be reduced for individuals with high PALs and false negative diagnoses for individuals with low PALs. While they suggest that this classification be confirmed with the measurement of actual BMR, this was not feasible in the present study.

[4]Durnin and Womersley (1974) derive age and sex specific formulas to estimate density using the logarithm of the sum of four skinfolds log(biceps+triceps+iliac crest+subscapular). Body fat is calculated using Siri's equation (1956) where: % body fat= (4.95/density) - 4.5 x 100.

equations against Deuterium oxide dilution (D_20) has revealed that the Durnin equation successfully predicts D_20% body fat (r=0.91 SEE=3.8%) using the Holtain calliper (Zillikens and Conway 1990).

Calculated using Heymsfield's 'corrected' formula based on arm circumference and triceps skinfold, arm muscle area (AMA) is used to indicate changes in lean body tissue (Heymsfield et al. 1982)[5]. In response to the finding that Jelliffe's equations (1969) over-estimate arm muscle area due to the inclusion of mid-arm cross-sectional bone area and the incorrect assumption that the mid-arm muscle compartment is circular, Hemysfield et al. (1982) have derived a quantitative correction that permits the calculation of absolute bone-free AMA. Although these corrected equations are more accurate, the wide 95% prediction intervals indicate their approximate nature (+-8% of actual AMA).

d) Case Inclusion and Seasonal Analysis

Given the longitudinal nature of the anthropometric data set, and the purpose of comparing age and gender groups over time, strict critera for case inclusion/exclusion are requisite. To this end, anthropometric measurements are grouped into three seasonal periods: Harvest (November to February); Dry (March to June); Rainy (July to October). For a case to be retained in the study sample, at least two measurements are necessary in each of these three seasonal periods. Women in the 2nd or 3rd trimester of pregnancy are excluded from the sample as are infants under the age of 3 months. Retained cases are followed as cohorts throughout the study.

In order to assess the statistical significance of seasonal fluctuations in nutritional status, composite indicators representing harvest, dry and rainy seasons are calculated by taking the mean of four monthly measurements corresponding with each seasonal period. After having confirmed the multivariate normal distribution of each of these dependent seasonal variables,

[5]Heymsfield's (1982) 'corrected' equation for arm muscle area (AMA) is based on measures of mid-arm circumference (MAC) and triceps skinfold (TSF) using the formula $((MAC-\pi TSF)^2/4\pi)-10$ for males, and $((MAC-\pi TSF)^2/4\pi)-6.5$ for females.

repeated measures analysis of variance is used to analyze the statistical significance of seasonal variation and to test for any interactions attributable to age or gender (Chapter II).

4.2 Seasonal Nutritional Risk of Children Under Five

For a cohort of children aged 3-59 months at the beginning of the study, Figures 4.1, 4.2 and 4.3 depict monthly changes in the standard nutritional indicators weight-for-height (w/h), height-for-age (h/a) and weight-for-age (w/a) expressed in terms of 'z-scores'[6]. As Figures 4.1 and 4.3 indicate, monthly patterns for the indicators w/h and w/a are somewhat similar. Both w/h and w/a 'z-scores' reach their lowest point in December, whereupon, female 'z-scores' rise gradually in subsequent harvest and dry season months (January-May), and deteriorate in the rainy season (June-September). Consistently above the female curve, male 'z-scores' rise sharply in the harvest season and then progressively deteriorate through the dry and rainy seasons. The gap between male and female scores widens during the harvest period and closes during the rainy season.

Distinct seasonal patterns are also evident for the indicator h/a. Although male 'z-scores' are below female values initially, in the dry season (March-June) they progressively increase and surpass the female curve. In both genders, a decrease in h/a is evident in the rainy season.

[6]For the purposes of assessing seasonal variation, it is preferable to compare children with themselves over time. This method circumvents concern about the use of international (western) reference data as a means of evaluating nutritional risk in genetically and ecologically specific populations (Van Loon et al. 1986), and provides for errors in the estimation of age; even if a child is wrongly aged at the time of the first measurement, the changes over time recorded for that child are still valid (Rosetta 1988:187).

Figure 4.1 Weight-for-height Z-Scores of Children <5 Years by Month and Gender

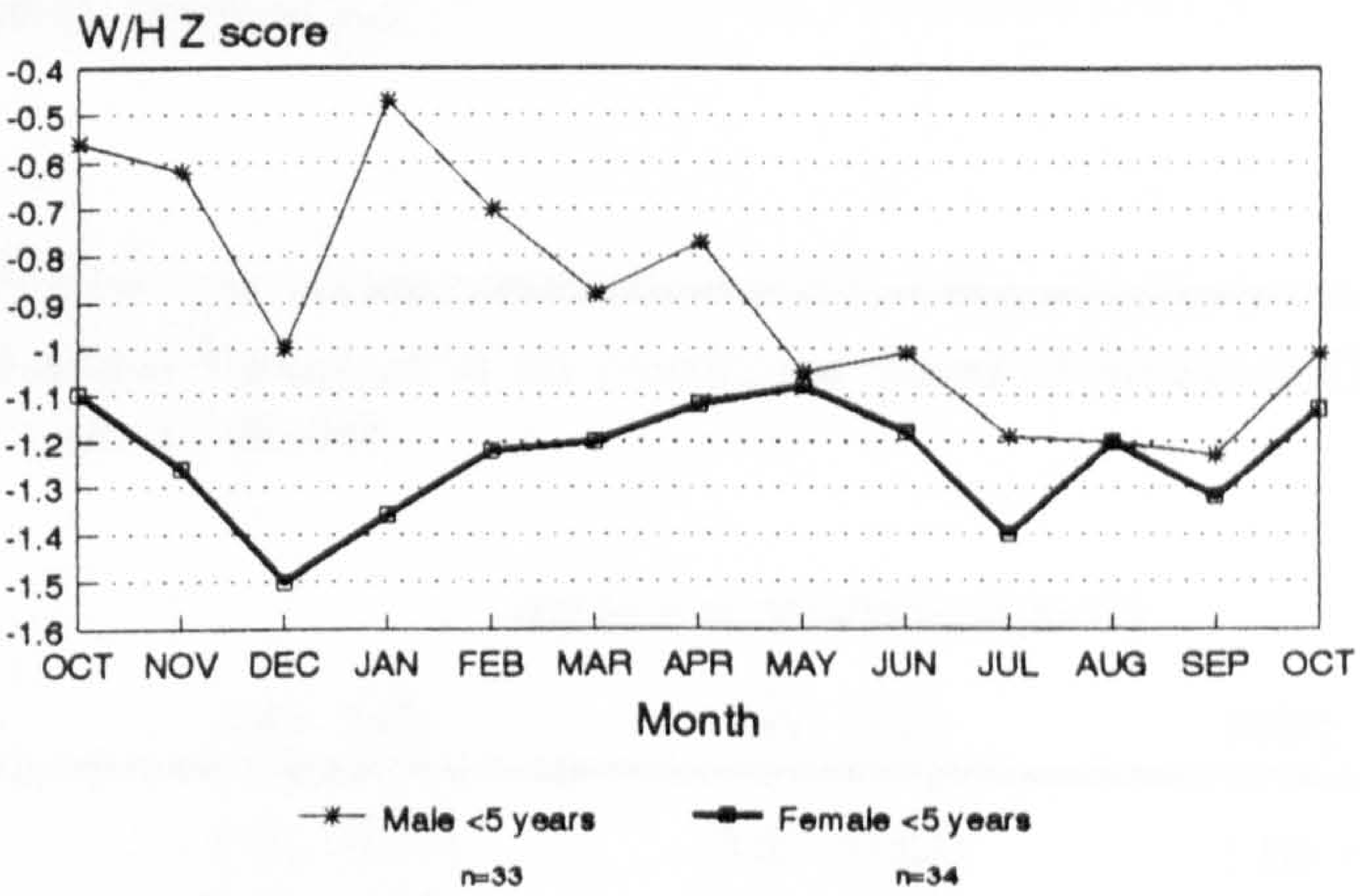


Figure 4.2 Height-for-Age Z-Scores of Children <5 Years by Month and Gender

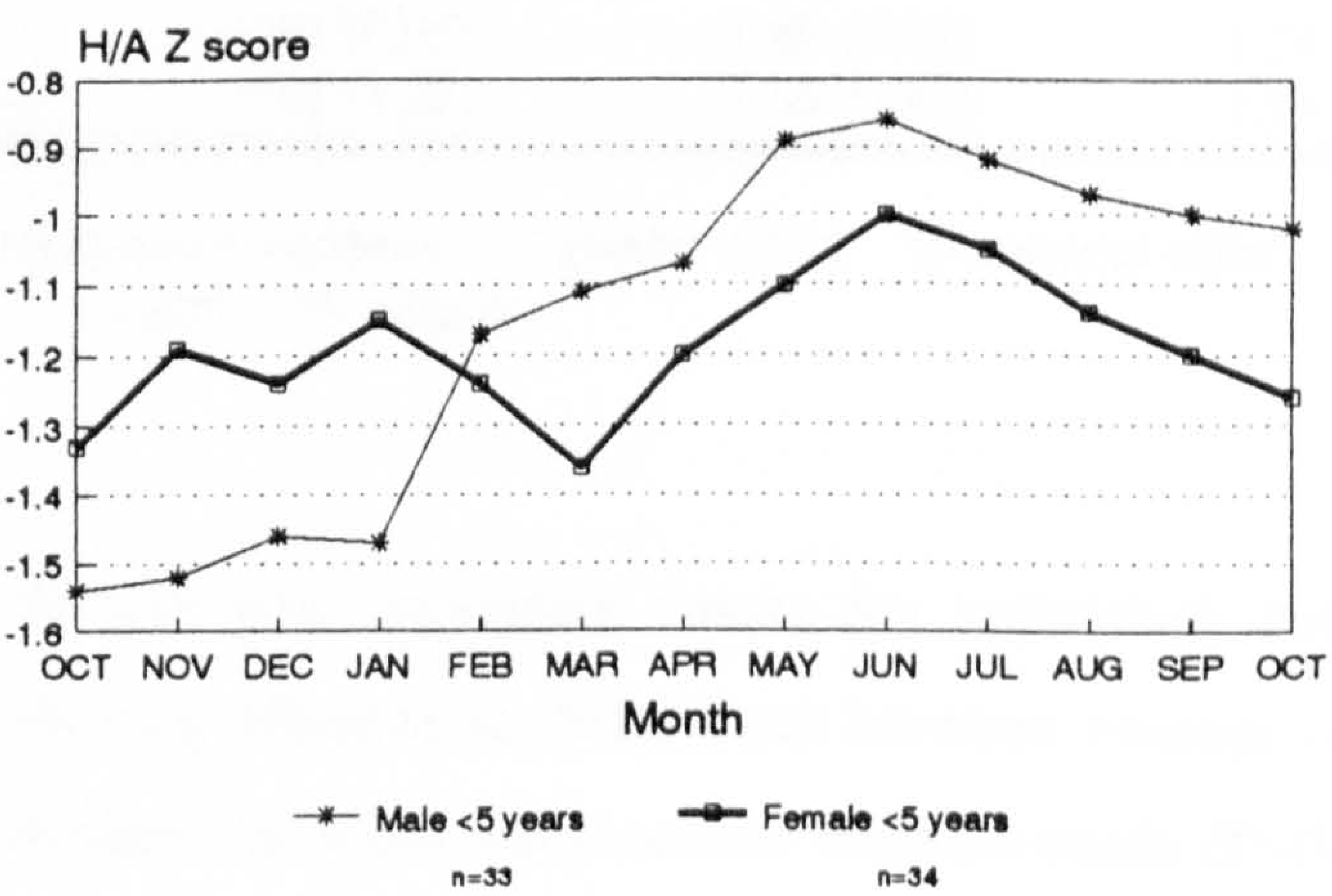
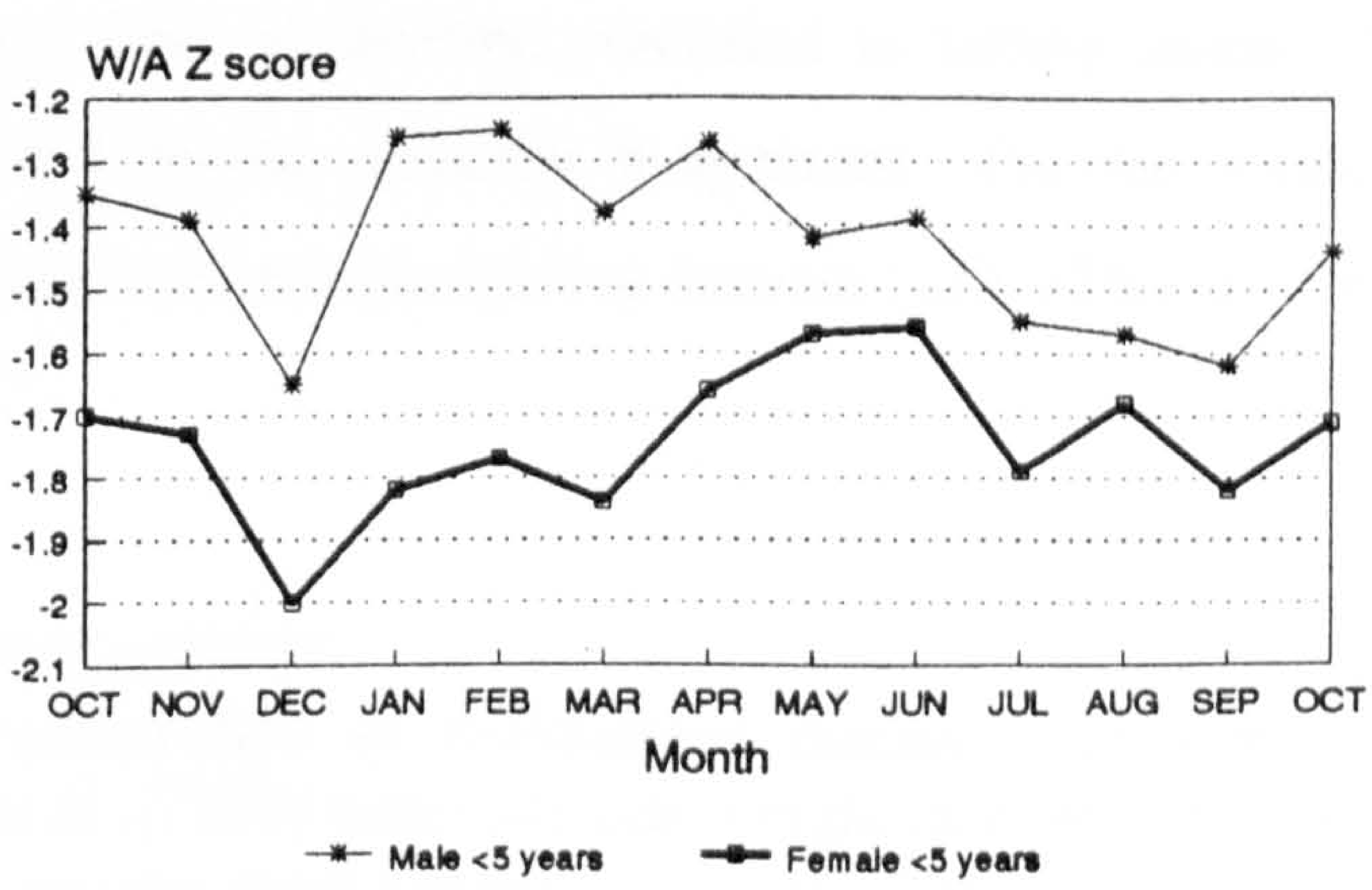


Figure 4.3 Weight-for-Age Scores of Children <5 Years by Month and Gender



Sebekoro, Mali

Using composite seasonal variables derived from monthly measurements, repeated measures analysis of variance reveals statistically significant variations between seasons for all indicators (w/h p<0.01; h/a and w/a p<0.05). However, the between-subjects factor 'gender' is found to have no significant effect (Table 4.1). The greater significance of seasonal variation in w/h (f=5.20 p<0.01) suggests that it is the anthropometric indicator most sensitive to short-term seasonal fluctuation[7].

Table 4.1 Seasonal Variations in the Nutritional Status of Sèbèkoro Children Under 5 Years of Age by Gender

		mean z-scores/season n=66				
index	gender	harv (sd)	dry (sd)	rainy (sd)	I	II
w/h	M	-0.72 (0.95)	-0.87 (0.84)	-1.06 (0.75)	N/S	**
	F	-1.07 (1.05)	-1.12 (0.84)	-1.30 (0.67)		
h/a	M	-1.38 (0.95)	-1.14 (0.84)	-1.12 (0.75)	N/S	*
	F	-1.09 (1.05)	-1.07 (0.84)	-1.15 (0.67)		
w/a	M	-1.40 (0.95)	-1.40 (0.84)	-1.54 (0.75)	N/S	*
	F	-1.54 (1.05)	-1.56 (0.84)	-1.74 (0.67)		

Repeated measures analysis of variance: I gender effect II seasonal effect
N/S not significant * p<0.05 ** p<0.01

In the case of w/h and w/a, univariate f-tests for individual contrasts between seasons attributes most of this significance to differences between average measurements in harvest and dry seasons compared to mean rainy season measurements (f=10.30 p<0.01 for w/h and f=5.66 p<0.02 for w/a). No significant individual contrasts are apparent for the indicator h/a.

As regards the proportion of children classified as falling below -2 sd of the NCHS/CDC reference, very little seasonal variation is apparent. For the indicators w/h and h/a, a 2-3% increase in prevalence is found comparing harvest (w/h 12%; h/a 19%) and rainy (w/h 15%; h/a 21%) seasons.

[7]Based on a comparison of normalized distances between different anthropometric indicators, Briend et al. (1989) conclude that weight change, weight-for-height and mid-upper arm circumference are the most sensitive indices of short-term nutritional change.

Figure 4.4a Seasonal Height of Children <5 yrs Compared to NCHS Reference Curve

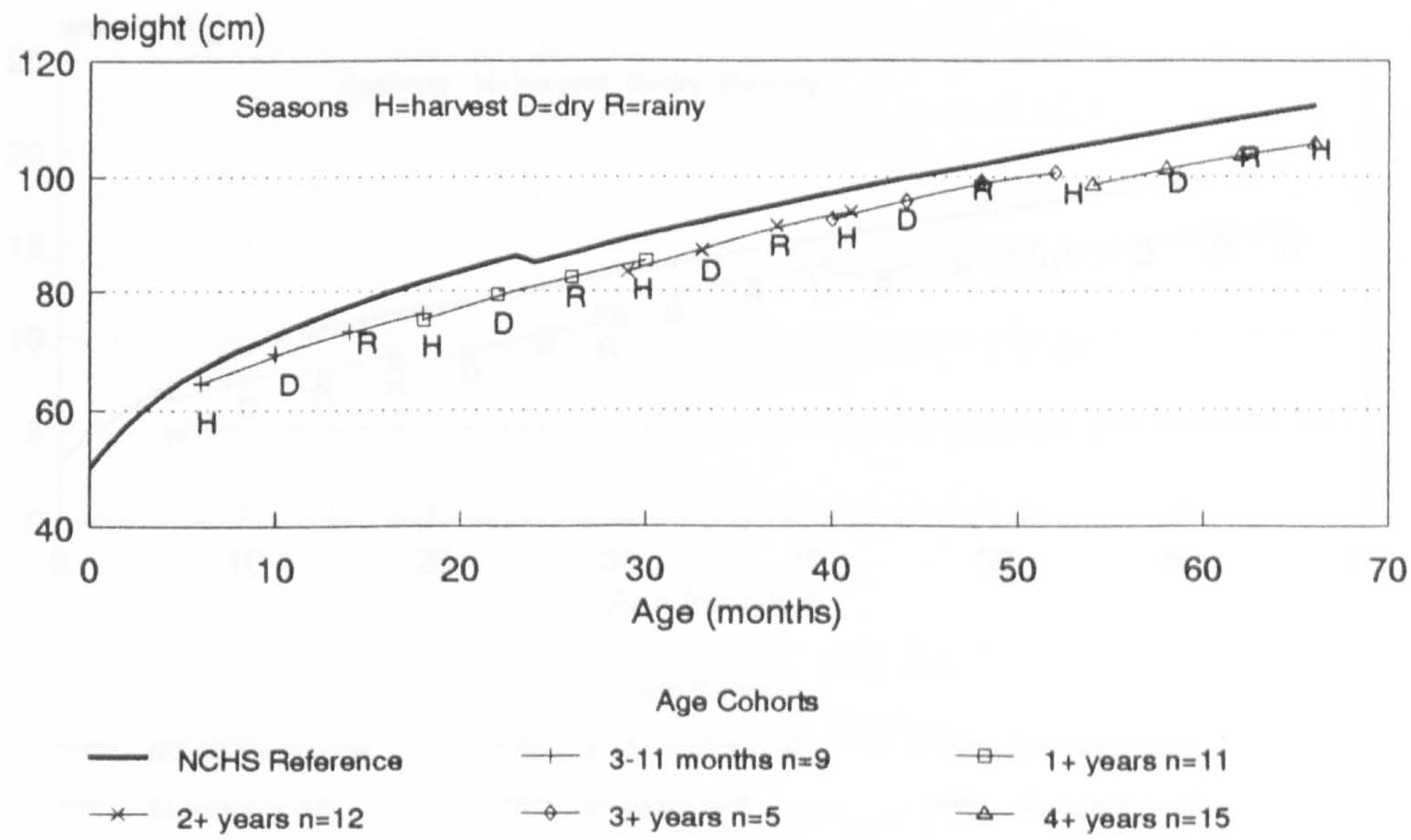
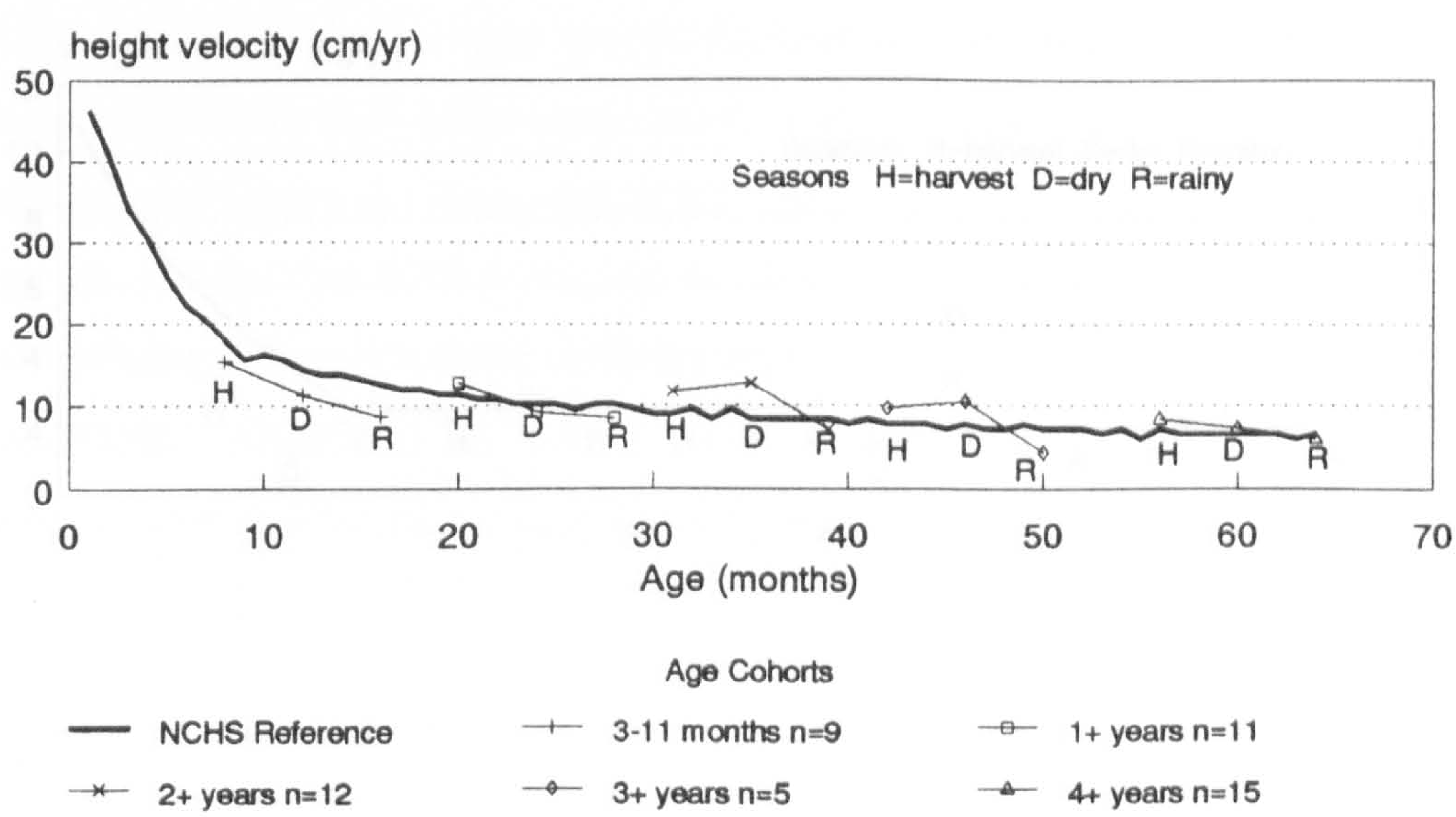


Figure 4.4b Seasonal Height Velocities of Children <5 yrs Compared to NCHS Reference Curves



Sebekoro, Mali

Fig 4.5a Seasonal Weight of Children <5yrs Compared to NCHS Reference Curve

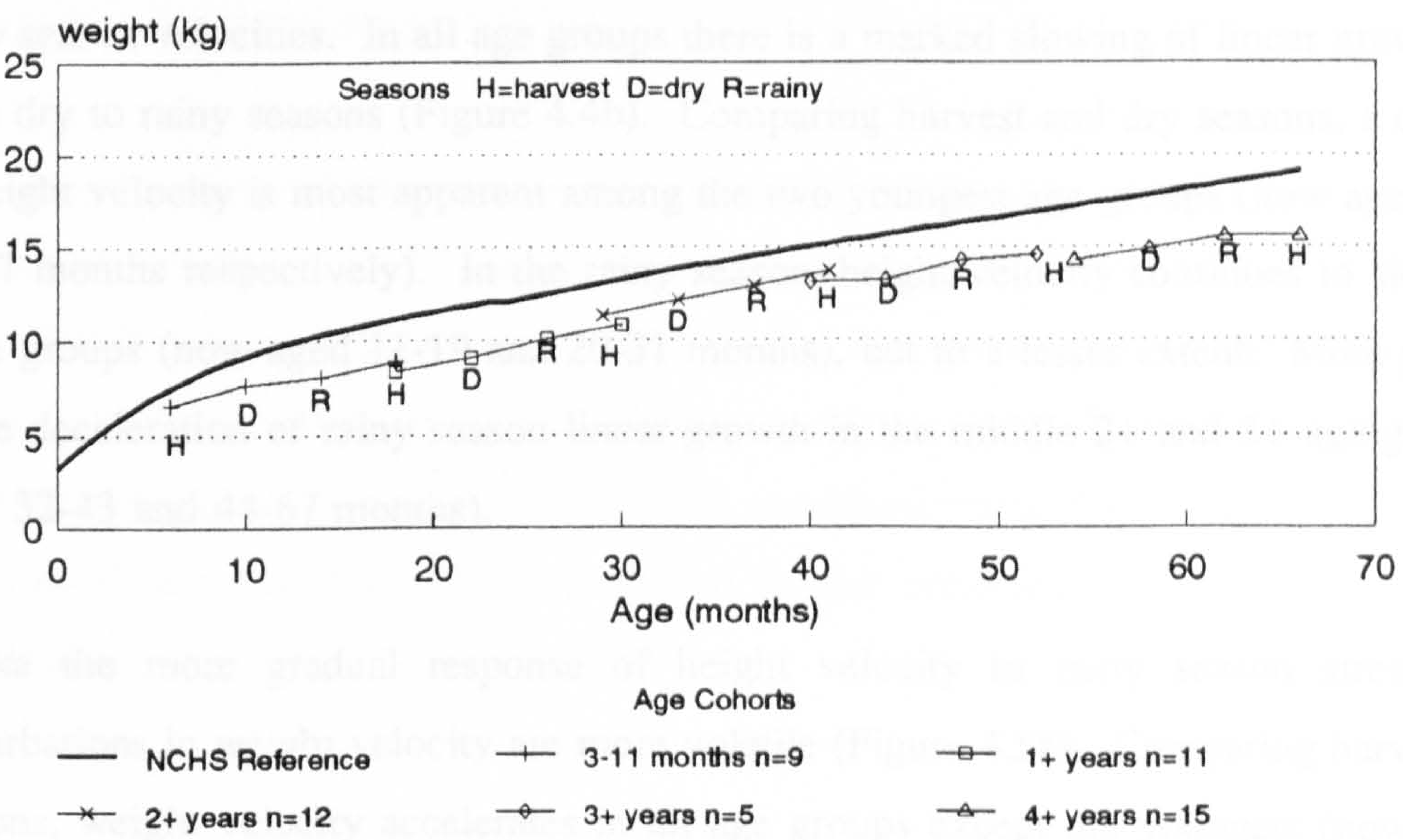
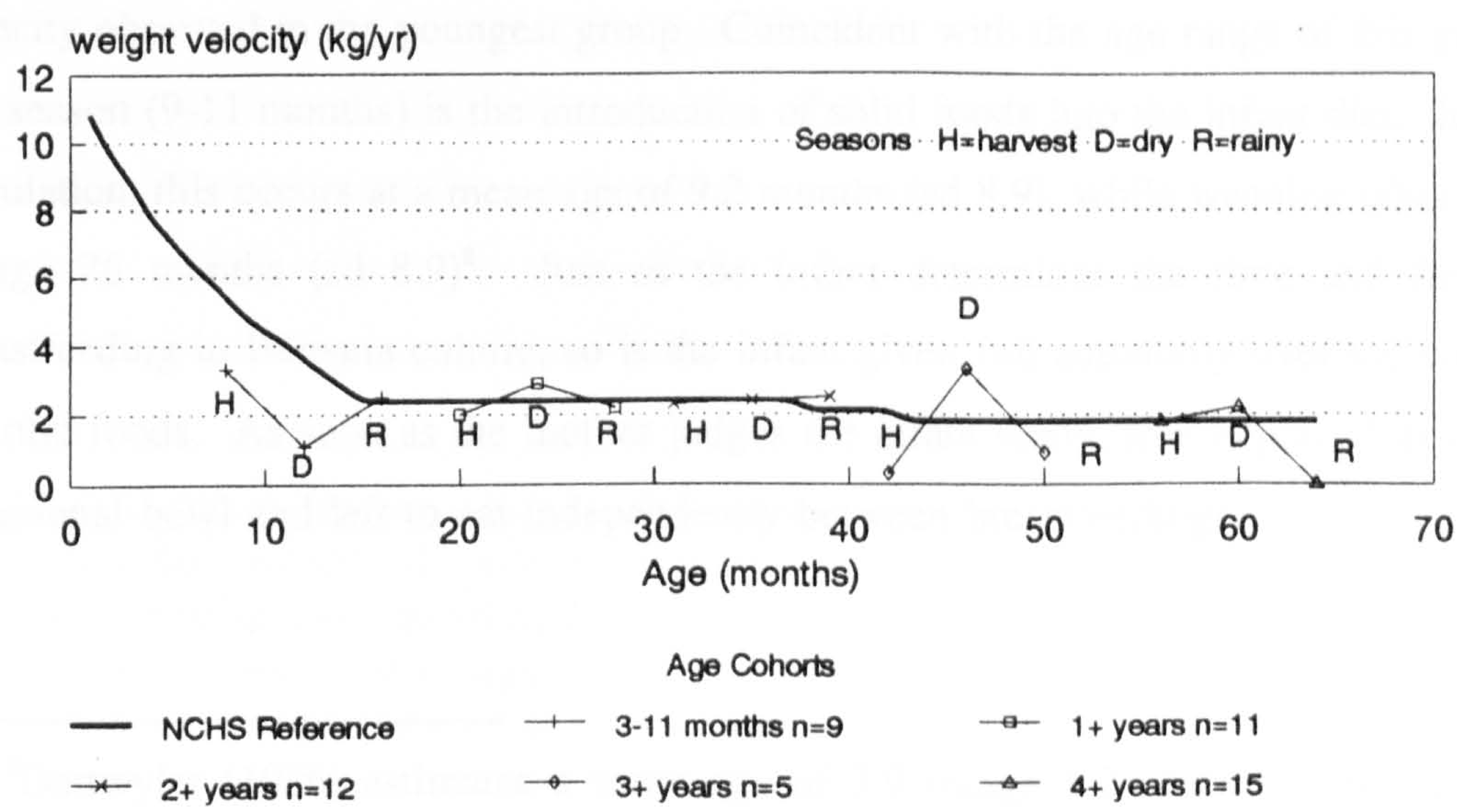


Figure 4.5b Seasonal Weight Velocities of Children (<5yrs) Compared to NCHS Reference Curves



Sebekoro, Mali

To make seasonal analysis more sensitive, children are divided into five groups based on their age at the beginning of the study: 3-11 months, 1+, 2+, 3+ and 4+ years. Figures 4.4a and 4.4b plot mean levels of height and height velocity for each age group against NCHS median reference curves, while Figures 4.5a and 4.5b do the same for weight and weight velocity. Seasonal growth velocity variables are computed from the difference between quarterly measurements of height and weight to create three data points representing harvest, dry and rainy season velocities. In all age groups there is a marked slowing of linear growth (height) from dry to rainy seasons (Figure 4.4b). Comparing harvest and dry seasons, a deceleration in height velocity is most apparent among the two youngest age groups (now aged 7-15, and 16-27 months respectively). In the rainy season, height velocity continues to slow in these same groups (now aged 11-19 and 20-31 months), but to a lesser extent. More pronounced is the deceleration of rainy season linear growth in the middle 2+ and 3+ age groups (now aged 32-43 and 44-67 months).

Unlike the more gradual response of height velocity to rainy season stress, seasonal perturbations in weight velocity are more volatile (Figure 4.5b). Comparing harvest and dry seasons, weight velocity accelerates in all age groups except the youngest (now aged 7-15 months). With the onset of the rainy season, weight velocity correspondingly slows or remains the same for all age groups with the exception of the youngest group now 11-19 months of age.

Several hypotheses might be advanced to explain the anomalous fluctuations in weight velocity observed in the youngest group. Coincident with the age range of this group in the dry season (9-11 months) is the introduction of solid foods into the infant diet. In the study population, this occurs at a mean age of 9.2 months (sd 8.9), while weaning takes place later at age 26 months (sd 8.9)[8]. Just as the infant determines the time and frequency of breastfeeding in Bamana culture, so is the infant given full autonomy over the consumption of solid foods. As soon as the mother judges the infant ready, s/he is placed in front of the communal bowl and left to eat independently between breastfeedings.

[8]Dettwyler (1986) estimates a mean age of 7.9 (range 3-24 months) in her peri-urban study of Bamana feeding practices, while Mondot-Bernard (1982) reports an average of 10-11 months for rural Malian children.

It is conceivable that growth faltering observed in the dry season may be the cumulative result of the growing inadequacy of breastmilk to meet the nutritional needs of the infant after 6 months of age, the laissez-faire introduction of supplementary foods characteristic of Bamana culture, and related difficulties associated with the dietary transition from breastmilk (FAO/WHO/UNU 1985, Dettwyler 1986,1987). It is also possible that the loss of passive immunity at six months of age further increases the risk of infection and infection-induced growth faltering (Schofield 1974:27).

The recovery of weight velocity in the wet season might be expected as the younger group overcomes this transitional stage. Furthermore, unlike older children left with grandmothers and siblings in the village, the younger age group (now aged 11-19 months) generally accompany their mothers to the field during the rainy season. The growth faltering of older children in the rainy season may well be the combined effect of food scarcity, morbidity and maternal time constraints militating against regular breastfeeding and supplementary meal preparation[9].

4.3 Seasonal Nutritional Risk of Children Aged 5 to 15 years

To assess seasonal variations in the nutritional status of older children in Sèbèkoro, anthropometric data is analyzed by age group: the first group comprises children aged 5-9 and the second includes those aged 10-15 at the beginning of the study. These age groupings are considered appropriate given the tendency for BMI to remain constant through the 5-9 age range (Waterlow et al. 1977, Sukkar et al. 1982). Greater variation in BMI and growth velocity is characteristic of the adolescent group given inter-individual differences in the onset of puberty and associated changes in reproductive and secondary gender characters, and in body size, shape and composition (Tanner 1978:60).

---

[9]In a study of seasonal changes in activity, birthweight and lactational performance in rural Gambian women, Roberts et al. (1982) note a reduction in lactational performance (~25%) in relation to maternal activities which necessitate the separation of mother and child. Seasonal variations in the energy intake of Gambian infants have also been observed: both the breast-milk intake of children aged 6 months+, and the traditional weaning food intake of children in the second half of infancy appear to fall during the rainy season (Rowland et al. 1981).

The mean population characteristics of age and gender groups in this analysis are presented in Table 4.2. Although the female sample appears younger in both 5-9 and 10-15 age groups, this difference is only significant in the latter group ($p<0.05$). This age differential is due to the exclusion of 12 adolescent girls from the sample who had migrated to Bamako as domestics for the duration of the dry season. Significantly lower measurements of height among females aged 10-15 compared to males in the same age range ($p<0.05$) are explained by this difference in the age distribution of male and female samples.

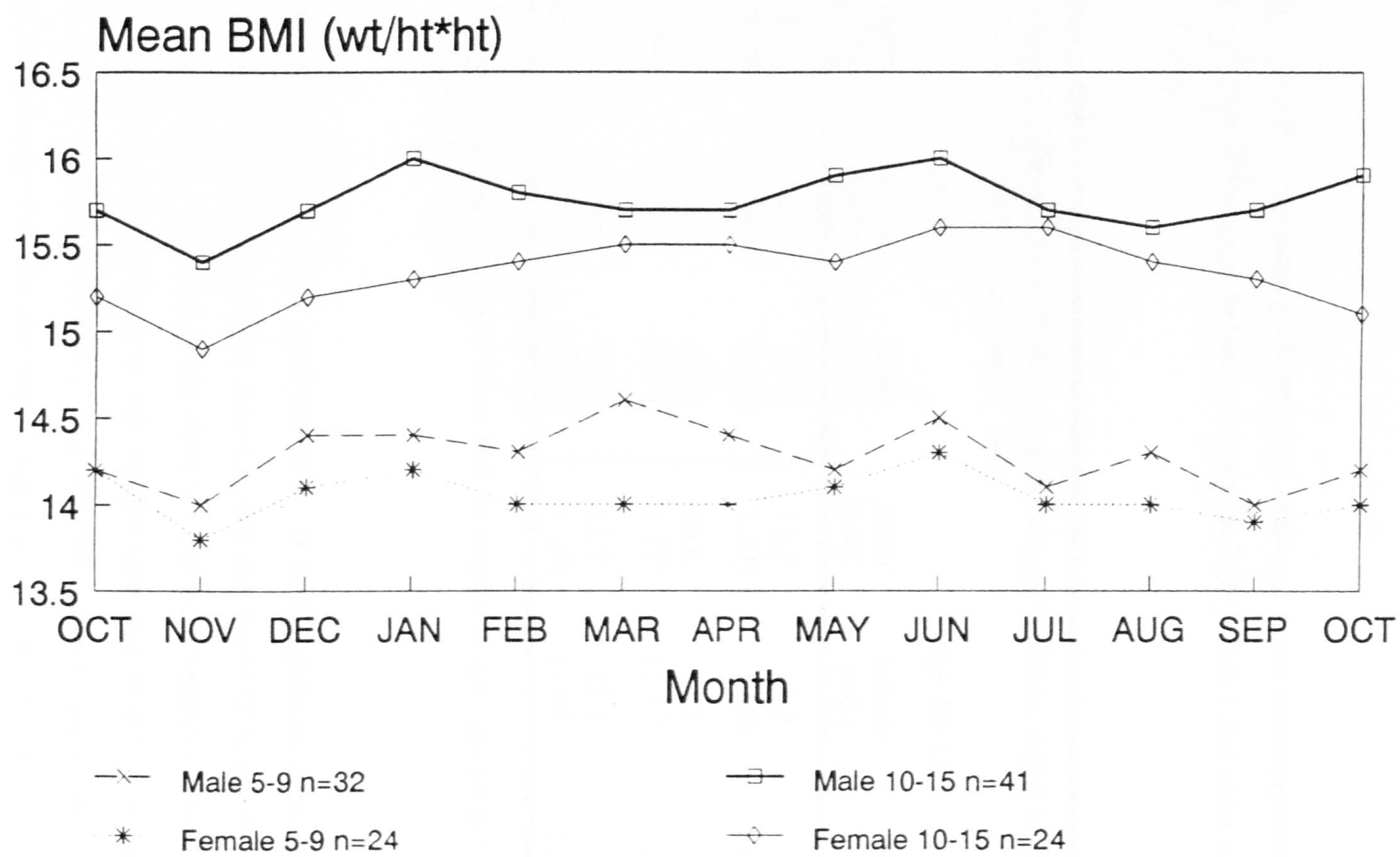
Table 4.2 Population Characteristics of Sèbèkoro Children aged 5-15 by Age and Gender Group: mean (sd)

	age 5-9			age 10-15		
	n=32	n=24		n=41	n=24	
indicator	male	female	I	male	female	I
age (yr)	7.1 (1.19)	6.6 (1.14)	N/S	11.9 (1.27)	11.0 (1.33)	*
weight (kg)	20.8 (3.60)	19.9 (3.56)	N/S	33.1 (6.04)	30.1 (7.22)	N/S
height (cm)	120.4 (9.17)	118.4 (8.64)	N/S	144.5 (9.43)	139.5 (8.89)	*
armcir (cm)	15.3 (1.98)	16.2 (1.24)	N/S	19.1 (2.12)	18.1 (2.61)	N/S
BMI (kg/m^2)	14.3 (0.76)	14.1 (0.85)	N/S	15.7 (1.13)	15.4 (1.65)	N/S
wt vel (kg/yr)	2.0 (1.10)	1.6 (0.97)	N/S	2.7 (1.88)	2.7 (1.78)	N/S
ht vel (kg/yr)	5.7 (1.48)	5.5 (1.02)	N/S	4.7 (1.74)	5.3 (1.56)	N/S

One-way analysis of variance: I gender effect N/S not significant * $p<0.05$

Figure 4.6 presents monthly fluctuations in BMI according to age and gender group. In both age groups, female BMI lies consistently below male levels which may well be an artefact of the slightly younger age of the female sample.

Figure 4.6 BMI by Month and Gender of Children 5-9 and 10-15 Years



Sebekoro, Mali

Most notable is the constancy of BMI over time. The undulating patterns of BMI in all age and gender groups coincide in November when BMI appears to drop, followed by a period of recovery in the harvest months of December and January. Another slight but general rise in BMI is registered in June before it drops in the rainy season months of August and September.

Repeated measure analysis of variance performed on seasonal mean measurements of BMI reveals significant seasonal differences in both younger ($f=7.20$ $p<0.01$) and elder age groups ($f=8.50$ $p<0.001$) (Table 4.3).

Table 4.3 Seasonal Variations in BMI among Sèbèkoro Children Aged 5-15 by Age and Gender Group: kg/m^2 (sd)

	age 5-9:			age 10-15:		
season	male n=32	female n=24	both n=56	male n=41	female n=24	both n=65
harvest	14.3 (0.80)	14.1 (0.90)	14.2 (0.84)	15.7 (1.13)	15.2 (1.65)	15.5 (1.36)
dry	14.4 (0.87)	14.1 (0.81)	14.3 (0.85)	15.8 (1.17)	15.5 (1.67)	15.7 (1.34)
rainy	14.2 (0.95)	14.0 (0.79)	14.1 (0.89)	15.7 (1.19)	15.4 (1.68)	15.6 (1.39)

Repeated measures analysis of variance: I gender effect: N/S II seasonal effect: age 5-9 $p<0.01$; age 10-15 $p<0.001$ III age group effect: N/S

In the younger group, univariate f-tests attribute most of this significance to differences between the average BMI in harvest and dry seasons, and the lower BMI registered in the rainy season ($f=12.20$ $p<0.001$). However, in the elder age group, differences between harvest and dry season contrasts account for most of this significance due to the increase in BMI experienced in this period ($f=16.46$ $p<0.0001$). The between-subject factor 'gender' has no significant effect in this model, nor does the factor 'age group' when children aged 5-15 are analyzed together.

If data are expressed in terms of standard growth velocities per annum, calculated by taking the difference between quarterly measurements of height and weight, more striking seasonal variations are revealed. Repeated measures analysis of height velocity of children in the 5-9 age group indicates a significant 'catch-up' in height velocity from harvest to dry seasons, followed by an equally significant decrease in velocity with the onset of the rainy season (har and dry f=8.12 $p<0.01$; har/dry and rainy f=4.77 $p<0.05$) (Table 4.4). Significant trends in height velocity are not apparent in the elder age group characterized by less dramatic seasonal variation and slightly larger standard deviations for all velocity variables.

Table 4.4 Seasonal Variations in Height Velocity among Sèbèkoro Children Aged 5-15 by Age and Gender Group: cm/yr (sd)

	age 5-9:			age 10-15:		
season	male n=32	female n=24	both n=56	male n=41	female n=24	both n=65
harvest	5.4 (3.75)	4.6 (2.09)	5.0 (3.15)	4.8 (3.13)	4.3 (2.69)	4.6 (2.97)
dry	6.8 (3.53)	7.1 (2.94)	6.9 (3.27)	5.4 (3.63)	6.2 (2.65)	5.7 (3.30)
rainy	4.9 (2.53)	4.8 (2.79)	4.8 (2.62)	3.7 (2.80)	5.3 (3.29)	4.3 (3.07)

Repeated measures analysis of variance: I gender effect: N/S II seasonal effect: age 5-9 p<0.01; age 10-15 N/S III age group effect: N/S

As summarized in Table 4.5, repeated measures analysis of variance indicates significant seasonal variation in weight velocity in both the younger and elder age groups ($p<0.001$). In the younger age group, univariate f-tests for individual contrasts reveals a significant increase in weight velocity comparing harvest and dry seasons, followed by a significant decrease in velocity with the rainy season (har and dry f=7.90 $p<0.001$; har/dry and rainy f=9.19 $p<0.001$).

Table 4.5	Seasonal Variations in Weight Velocity among Sèbèkoro Children Aged 5-15 by Age and Gender Group: kg/yr (sd)					
	age 5-9:			age 10-15:		
season	male n=32	female n=24	both n=56	male n=41	female n=24	both n=65
harvest	2.1 (3.05)	0.7 (3.05)	1.5 (3.10)	3.2 (4.17)	3.7 (5.04)	3.4 (4.47)
dry	3.2 (3.16)	3.5 (2.84)	3.3 (3.00)	3.5 (4.28)	4.1 (2.46)	3.8 (3.71)
rainy	0.8 (2.90)	0.6 (3.25)	0.7 (3.03)	1.3 (5.11)	0.03 (3.45)	0.9 (4.58)

Repeated measures analysis of variance: I gender effect: N/S II seasonal effect: age 5-9 $p<0.001$; age 10-15 $p<0.001$ III age group effect: N/S

In the case of older children, univariate analysis attributes most of this significance to differences between higher average weight velocities during harvest and dry seasons, and the lower mean velocity measured in the rainy season ($f=14.48$ $p<0.0001$). Despite these differences, no significant gender or age group effects on weight velocity are detected.

When seasonal nutritional variables are expressed in terms of 'z-scores' based on median NCHS reference values, it appears that the height and weight of children in both age ranges are well below median values in every season (Table 4.6)[10]. In the younger age group, h/a 'z-scores' are just below the median, lying between the 20-30th percentiles of the NCHS reference. By contrast, w/a is well below average, with mean 'z-scores' corresponding to the 12-20th percentile range. Analysis of variance reveals no significant gender differences for either indicator.

The 10-15 age group fare even less well relative to NCHS standards. The 'z-score' for h/a corresponds to the 10-15th percentile range of the reference while w/a lies in the 5-10th percentile range. As observed in the younger group, repeated measures analysis of variance detects no significant differences between genders for either indicator. When used to test the

[10]Because NCHS standards do not include values of w/h beyond 10 years of age, this indicator is not presented.

hypothesis that the 'z-scores' of younger and elder age groups are equal, analysis of variance reveals significant differences ($p<0.05$) between the two groups in both in dry (h/a f=4.29; w/a f=4.47) and rainy seasons (h/a f=5.82; w/a f=5.41).

Table 4.6 Seasonal Variations in the Nutritional Status of Sèbèkoro Children Aged 5-15 by Age and Gender Group

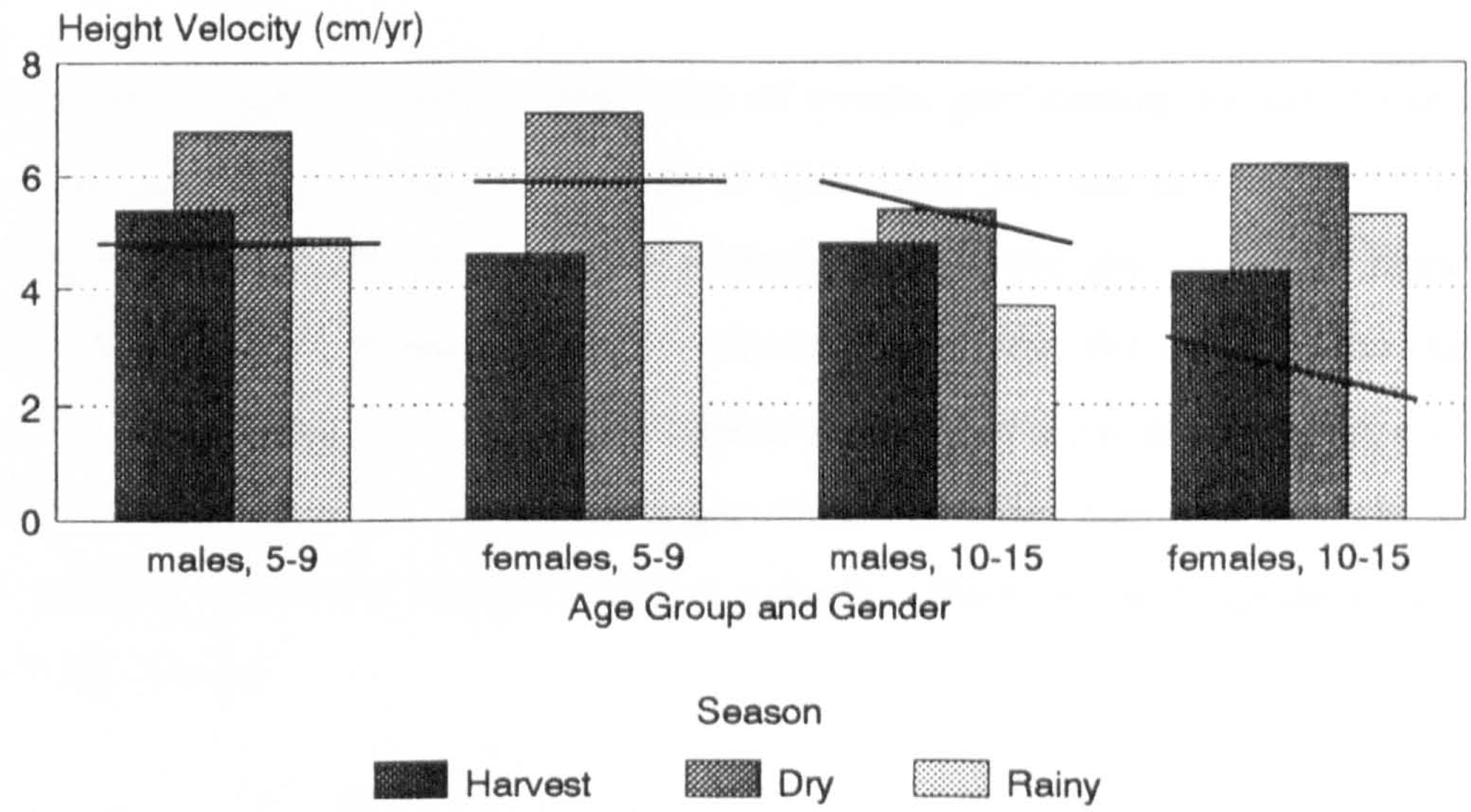
index	age group	n	gender	mean z-scores by season (sd) harv	dry	rainy
h/a	5-9	32	M	-0.97 (1.31)	-1.27 (1.10)	-1.23 (1.06)
	5-9	24	F	-1.34 (1.10)	-0.93 (1.31)	-0.92 (1.23)
	10-15	41	M	-1.49 (1.04)	-1.50 (1.03)	-1.57 (1.05)
	10-15	24	F	-1.61 (1.00)	-1.60 (0.98)	-1.57 (0.99)
w/a	5-9	32	M	-1.53 (0.86)	-1.45 (0.84)	-1.54 (0.86)
	5-9	24	F	-1.20 (1.01)	-1.18 (0.94)	-1.26 (0.92)
	10-15	41	M	-1.64 (0.76)	-1.68 (0.79)	-1.82 (0.75)
	10-15	24	F	-1.66 (0.80)	-1.62 (0.80)	-1.69 (0.79)

One-way analysis of variance: I gender effect: N/S II age group effect: $p<0.05$ in dry and rainy seasons

However, despite being in the lower percentiles of the reference, when seasonal growth velocities of Sèbèkoro children are compared to interpolated NCHS growth rates based on similar age ranges over time, some surprising trends are revealed[11].

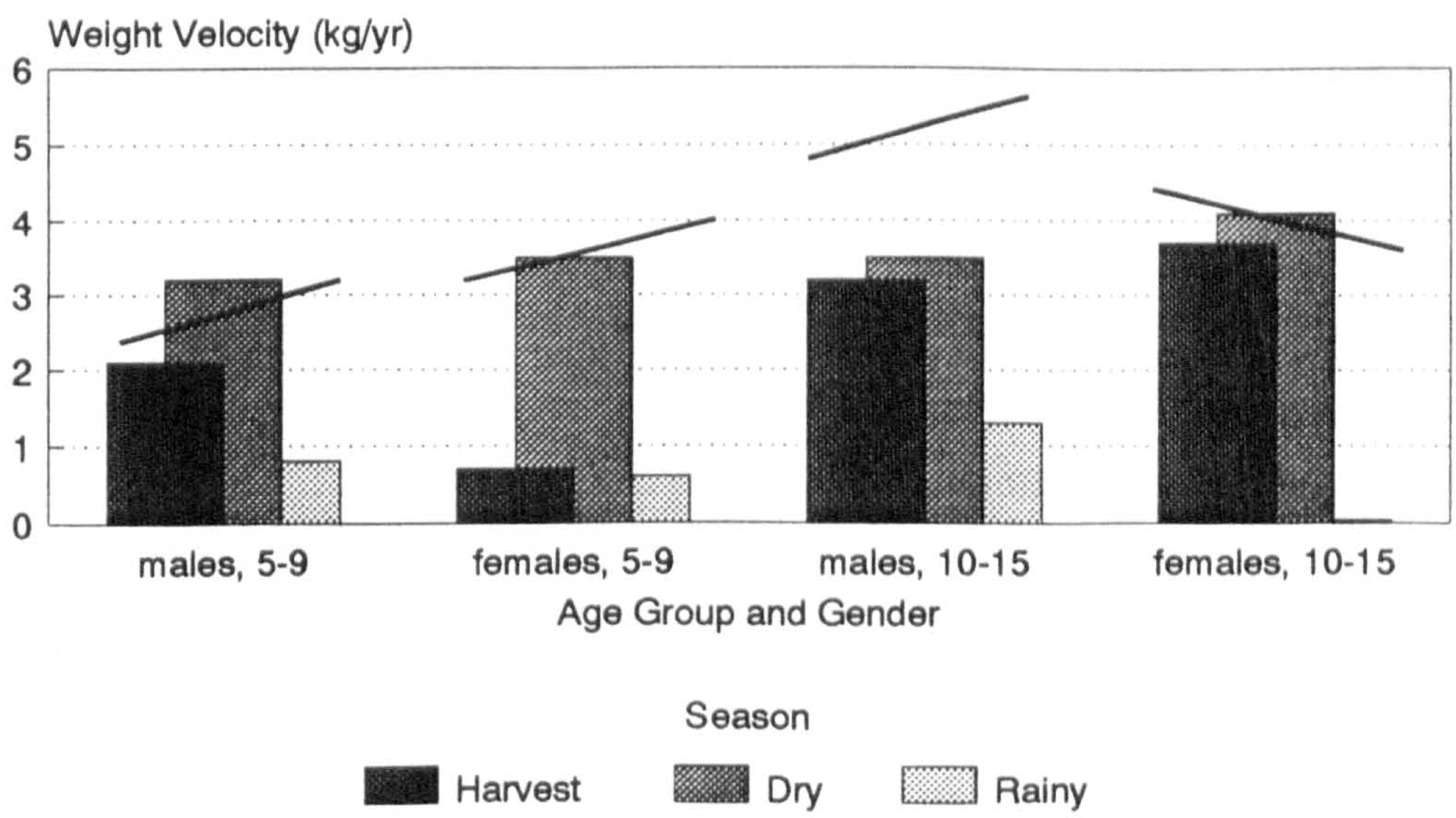
[11]In the absense of longitudinal growth rates for the age ranges used in analysis, it was necessary to interpolate growth rates from cross-sectional NCHS data. For this reason, they must be interpreted with due caution.

Figure 4.7 Height Velocity of Children
5-9 and 10-15 Years Compared to NCHS
Reference Velocity by Season and Gender



-- NCHS reference velocities

Figure 4.8 Weight Velocities of Children
5-9 and 10-15 Years Compared to NCHS
Reference Velocity by Season and Gender



-- NCHS reference velocities

Sebekoro, Mali

As Figure 4.7 illustrates, dry season height velocity appears to equal or exceed NCHS reference values for all age and gender groups. Indeed, it may be argued that this acceleration in height velocity represents a period of catch-up growth to compensate for rainy season growth faltering. A slowing of linear growth rates below NCHS standards occurs in the subsequent rainy season in all age and gender groups excepting girls aged 10-15 who continue to grow at a rate slightly above median NCHS velocities.

Compared to NCHS reference data, rates of weight gain during the harvest season are below the reference most notably in the case of girls aged 5-9 and boys aged 10-15 (Figure 4.8). Weight velocity in the younger group recuperates in the dry season to rates very close to NCHS values, only to plummet below the reference with the onset of the rainy season. In case of children aged 10-15, females appear to grow on a par with reference velocities in the harvest and dry seasons, while males grow more slowly. Like the younger age group, with the onset of the rainy season, weight velocity slows in both genders far below NCHS reference values.

In sum, results indicate that children aged 5-15 experience seasonal variation in both BMI and growth; height and weight velocities slowing in the rainy season and accelerating in the harvest and dry seasons[12]. This catch-up growth takes place regardless of what appears to be a chronic state of undernutrition relative to NCHS standards. Translation of seasonal nutritional indicators into 'z-scores' based on NCHS reference values seems to suggest a progressive deterioration of nutritional status as children grow older: mean 'z-scores' of children under five years of age are lower than the sample of children aged 5-9, which in turn are lower than 'z-scores' recorded in children aged 10-15.

As observed by Eveleth and Tanner (1990:168-169), the extended growth period and late maturation associated with poor environmental conditions may explain the particularly 'poor' nutritional status of children in the adolescent age group relative to NCHS reference values. As regards the rapid height velocity of girls aged 10-15 compared to other age/gender groups in the sample, a longitudinal study in Dakar, Senegal conducted by Michaut et al. (1972)

[12]The limited time frame of the study, however, makes it difficult to disentange seasonal effects from longer-term temporal influences. Interpretation might change were anthropometric data collected over a series of years.

revealed the skeletal maturity of girls and boys to be equally retarded at age 11. During puberty, however, considerable catch-up growth was experienced such that at age 15, girls had reached Tanner-Whitehouse standards while boys were 0.5 years below these standards.

4.4 Seasonal Nutritional Risk of Adults

Table 4.7 presents mean population characteristics for the adult male and female population aged 16 years and over. While mean age is similar between genders (males 40.9 yrs; females 41.1 yrs), they differ significantly in terms of other indicators of nutritional status. On average, men measure 172.7 cm and weigh 59 kg which corresponds to a BMI of 19.8 kg/m^2. Women are significantly shorter (161.0 cm; f=92.14 $p<0.0001$) and lighter than the male sample (50 kg; f=42.05 $p<0.0001$) with a mean BMI of 19.3 kg/m^2. Body fat percent is lower for men (male=13.8%; female=24.2%; f=154.53 $p<0.0001$) and arm muscle area (AMA) is significantly greater (male=37.7 cm^2; female=33.5 cm^2; f=11.94 $p<0.001$)[13].

Table 4.7 Population Characteristics of Sèbèkoro Adults Aged 16+ by Gender: mean (sd)

indicator	male n=63		female n=73	
age (yr)	40.9	(16.2)	41.1	(16.2)
height (cm)	172.7	(7.68)	160.9	(6.68)
weight (kg)	59.0	(8.68)	50.0	(7.57)
BMI (kg/m^2)	19.8	(2.05)	19.3	(2.28)
body fat (%)	13.8	(5.23)	24.2	(4.57)
AMA (cm^2)	37.7	(8.65)	33.5	(5.63)

[13]Compared to NHANES reference data for black Americans, adult height in the Sebekoro sample corresponds to the 25-50th percentile of the reference population. Body weight and BMI vary about the 5-10th percentile for men and about the 5th percentile for women. In the male population, AMA roughly corresponds to the 5th percentile while % body fat falls below this point particularly in the rainy season. Female AMA falls within the 25-50th percentiles in every season and % body fat within the 5-10th percentiles (Frisancho 1990: 143-161).

Evidence of correlations between age, indices of activity, and a number of anthropometric variables underlines the need to analyze adult data sets by age and gender group to more accurately identify those most vulnerable to seasonal fluctuations in nutritional status[14]. As the matrix in Table 4.8 indicates, strong correlations between age and activity ($r=-0.57$ $p<0.001$), fat and activity ($r=-0.53$ $p<0.001$) and age and fat ($r=0.61$ $p<0.001$) exist for the male sample.

In the female sample, weak correlations between nutritional indicators and activity are apparent which may be due to the unremitting nature of female work in rural Bamana society. However, correlations are apparent between age and indicators of body composition (age and fat $r=0.37$ $p<0.001$; age and AMA $r=-0.35$ $p<0.05$; age and BMI $r=-0.34$ $p<0.05$).

Table 4.8 Matrix of Correlations between Nutritional Variables, Age and Activity Indices in Sèbèkoro Adults Aged 16+

	men n=63			women n=73	
	AGE	ACTIVITY		AGE	ACTIVITY
AGE	1.00	-0.57**	AGE	1.00	-0.33*
ACTIVITY	-0.57**	1.00	ACTIVITY	-0.33*	1.00
BMI	0.27	-0.08	BMI	-0.34*	0.15
FAT	0.61**	-0.53**	FAT	0.37**	0.002
AMA	0.24	0.11	AMA	-0.35*	0.07

Pearson product-moment correlations with one-tailed probabilities: * p<0.01 ** p<0.001

These correlations are partly explained by the social and economic structure of Bamana society whereby household labour and the larger village community are organized according to the principles of generation and gender. It seems reasonable, therefore, to stratify the adult sample into age groupings which correspond with social-economic groupings in Bamana society. In the male population, the youngest age group (16-35 years) is involved in both household agriculture and the *cibò* labour group. The middle age group comprised of men

[14]See Appendix V for the derivation of activity indices.

aged 36-49 rarely participates in non-domestic agricultural work groups like the *cibò*, while the most elderly (50+ years) are generally retired from the labour force.

Among women, the youngest age group (16-35 years) is mainly concerned with domestic responsibilities such as food preparation, child care and fuel and water gathering, in addition to agriculture. As their reproductive years draw to a close in the middle age category (36-49 years), women are released from domestic responsibilities and free to pursue individual agricultural and other productive activities. The scope of these activities narrows in old age represented by the third age category comprising women aged 50+ years.

a) Seasonal Variation Among Adult Men

Figure 4.9 plots mean monthly BMI for young, middle and elder age groups in the male sample. Seasonal variations in BMI are particularly evident in the younger and middle groups with BMI reaching a peak in the dry season (April/May), and dropping to its lowest point in the rainy season (August/September). This drop in BMI corresponds to net weight loss ranging from 2.6 kg in the youngest group, to 2.1 kg and 1.7 kg in the middle and eldest groups respectively. Expressed as a percentage, the youngest age group experiences a loss of 3.8% mean body weight, while the middle group loses 2.8%, and the elder group, 2.7%.

These figures are in keeping with seasonal losses reported in the literature on West Africa. Benefice and Chevassus-Agnes (1985) report a loss of 2.8 kg for male Bamana farmers over 19 years of age in southern Mali. In the wake of a severe soudure season in Senegal, Rosetta (1986) notes a loss of 1.7 kg for agriculturalists less than 55 years of age, and 2.7 kg for those over 55 years.

Figure 4.10 indicates seasonal variations in monthly % body fat which closely resemble those observed for BMI. From a dry season nadir in April, body fat falls sharply in the months of August/September which constitutes a loss of 2.4% in the youngest group and 2.7% in both middle and eldest groups. When assessed in terms of BMI, greater seasonal loss of body fat tends to occur in men with BMIs over 18, compared to their leaner counterparts (BMI>18 2.3% loss; BMI<18 1.5% loss).

Figure 4.9 BMI by Month of Men According to Age Group

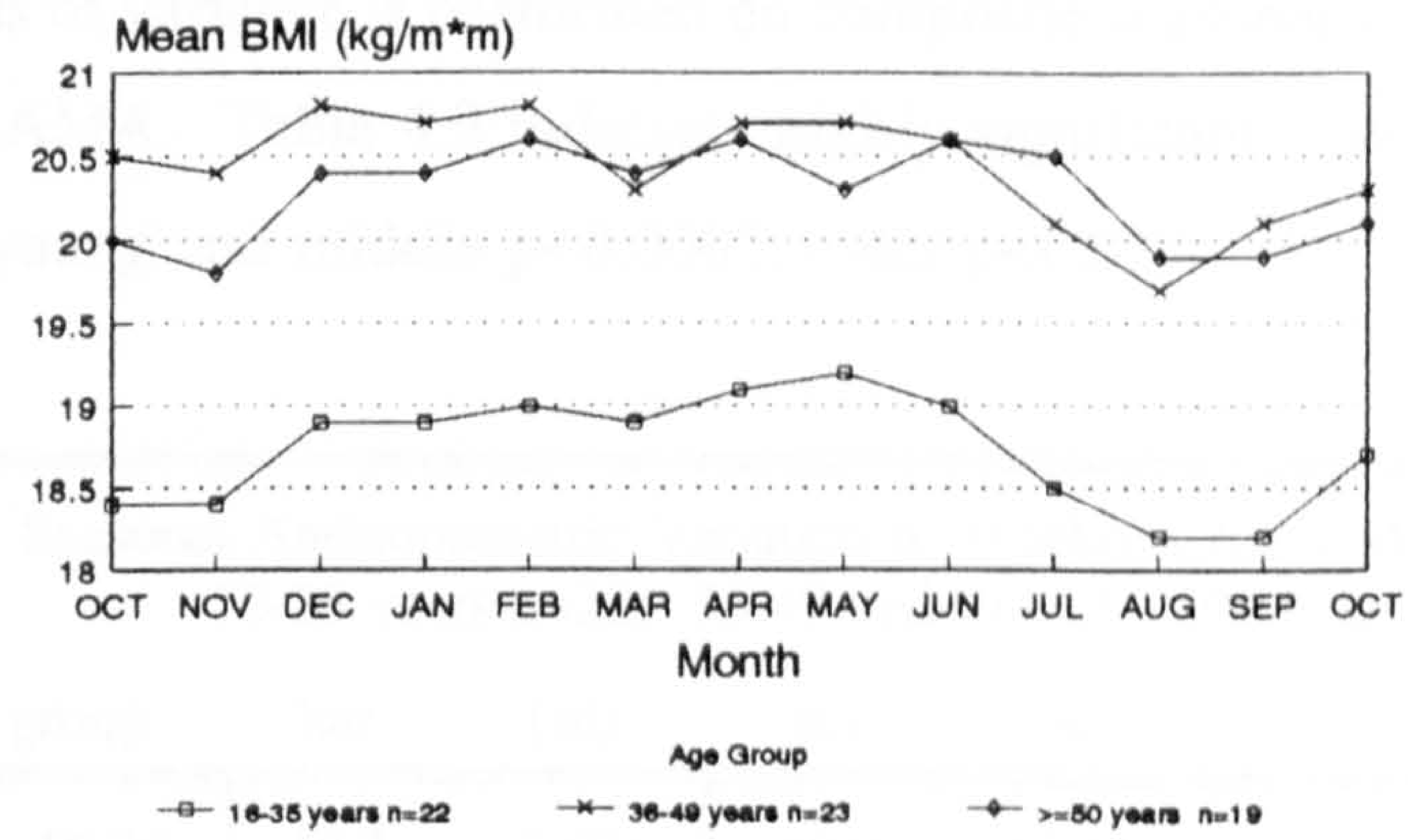


Figure 4.10 Percentage Body Fat by Month of Men According to Age Group

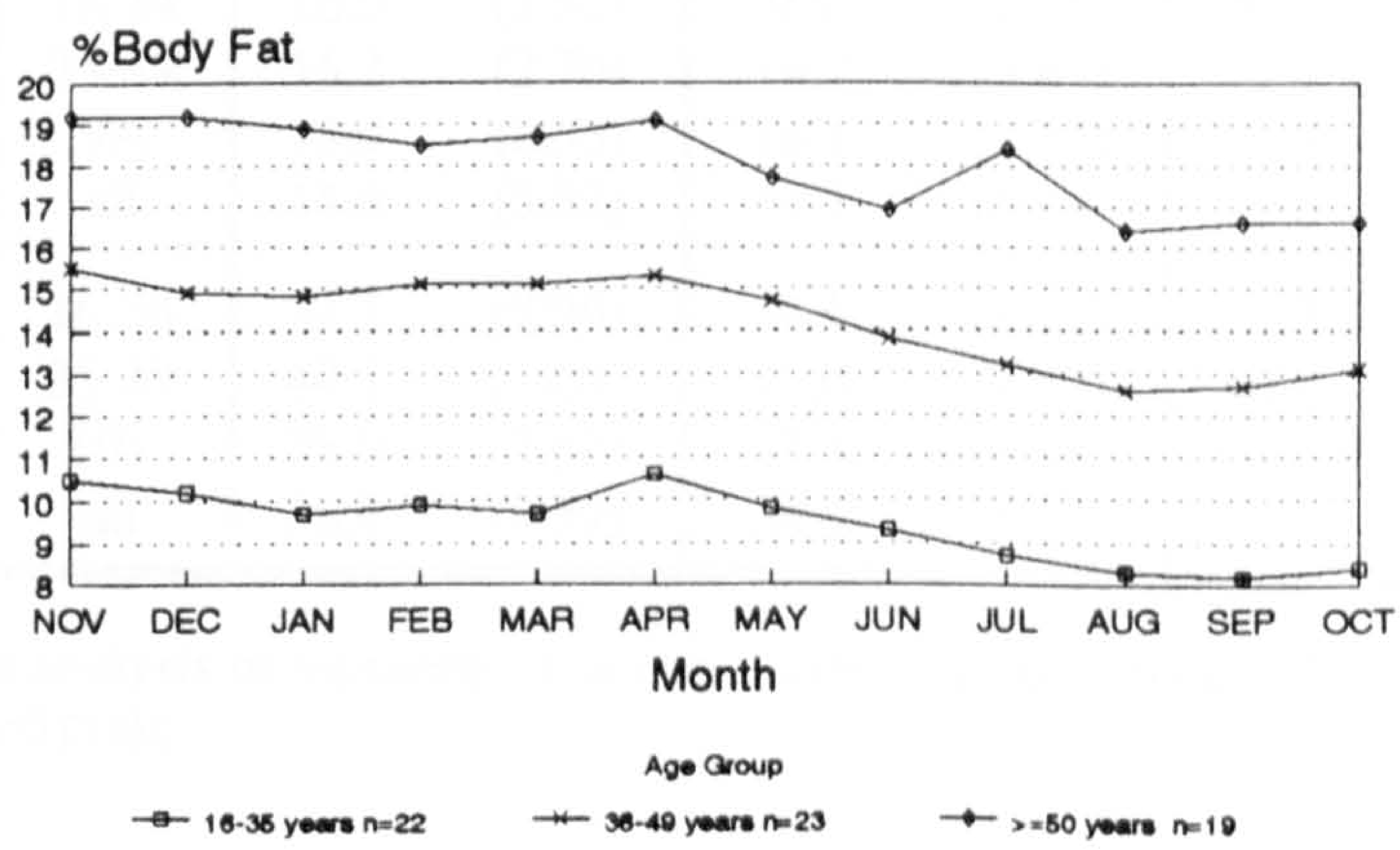
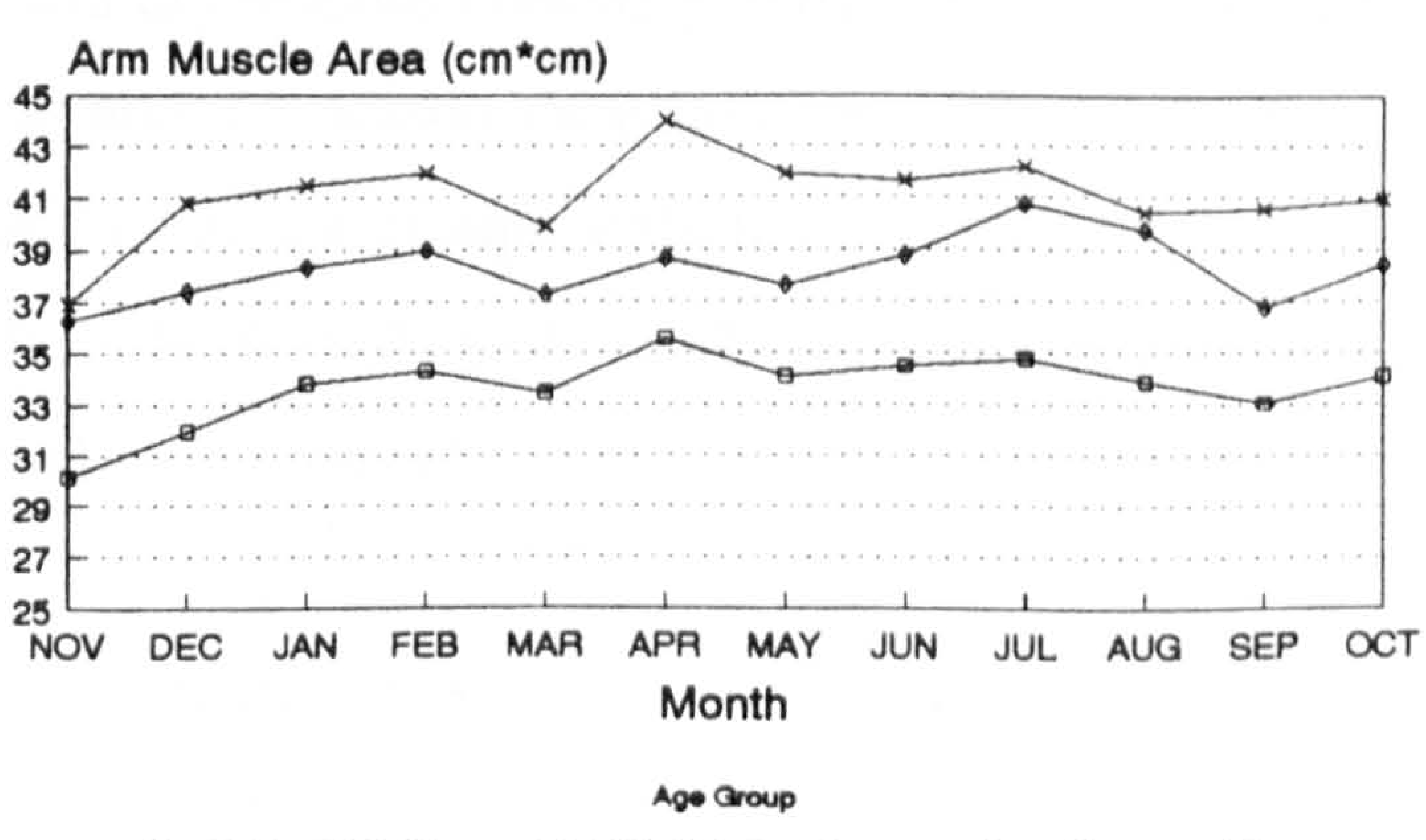


Figure 4.11 Arm Muscle Area by Month of Men According to Age Group



Sebekoro, Mali

Unlike graphs of BMI and body fat, monthly trends in mean AMA do not exibit any obvious seasonal pattern. From its lowest point at the beginning of the harvest, AMA rises and then fluctuates in subsequent months without an obvious seasonal pattern (Figure 4.11).

To assess the statistical significance of seasonal variations in nutritional indicators, repeated measures analysis of variance is performed on composite seasonal variables representing BMI, % body fat and AMA. Table 4.9 indicates highly significant seasonal variations in BMI in all age groups (young and middle $p<0.0001$; elder $p<0.01$).

Table 4.9 Seasonal Anthropometric Variation in Sèbèkoro Adult Men by Age Group
16-35 years n=22; 36-49 years n=23; 50+ years n=19

indicator	group	har	(sd)	dry	(sd)	rainy	(sd)	I	II
BMI (kg/m^2)	16-34	18.7	(2.07)	19.0	(2.04)	18.4	(1.98)	****	
	35-49	20.7	(1.37)	20.6	(1.48)	20.0	(1.38)	****	
	50+	20.3	(2.18)	20.5	(2.45)	20.0	(2.30)	**	
	all	19.9	(2.10)	20.0	(2.10)	19.5	(2.01)	****	N/S
body fat (%)	16-34	10.0	(2.81)	9.9	(2.35)	8.5	(2.11)	****	
	35-49	15.2	(2.70)	14.7	(2.83)	12.9	(2.32)	****	
	50+	18.9	(6.55)	18.1	(6.35)	16.9	(6.11)	****	
	all	14.6	(5.52)	14.1	(5.24)	12.6	(5.06)	****	N/S
AMA (cm^2)	16-34	32.3	(9.96)	34.1	(9.51)	34.0	(8.48)	**	
	35-49	40.3	(7.00)	42.0	(7.32)	40.9	(7.77)	**	
	50+	38.0	(7.62)	38.4	(8.16)	38.8	(7.82)	N/S	
	all	36.9	(8.59)	38.3	(8.87)	38.0	(8.43)	****	N/S

Repeated measures analysis of variance: I seasonal effect II age group effect N/S not significant
** $p<0.01$ **** $p<0.0001$

In the younger group, univariate f-tests attribute this significance to an increase in BMI between harvest and dry seasons ($f=8.02$ $p<0.01$), and a highly significant drop in BMI when comparing harvest and dry season measurements with the rainy season ($f=18.37$ $p<0.0001$). In both middle and elder age groups, only the latter rainy season drop is significant (middle $f=49.63$ $p<0.0001$; elder $f=10.04$ $p<0.01$). Despite these differences, no significant age group effects are detected by the model.

As expected, highly significant seasonal variations in % body fat are also observed using repeated measures analysis (Table 4.9). Most of this significance is due to differences between average fat measurements in harvest and dry seasons, and lower % body fat in the rainy season ($p<0.0001$ for all age groups). Univariate f-tests also identify significant reductions in body fat from harvest to dry seasons in middle ($f=6.63$ $p<0.05$) and elder ($f=10.29$ $p<0.01$) age groups. Once again, no significant age group effects are apparent. Significant seasonal variations in arm muscle area (AMA) are only found in the younger and middle age groups ($p<0.01$), mainly due to an increase in AMA between harvest and dry seasons (young $f=17.12$ $p<0.001$; middle $f=12.21$ $p<0.01$).

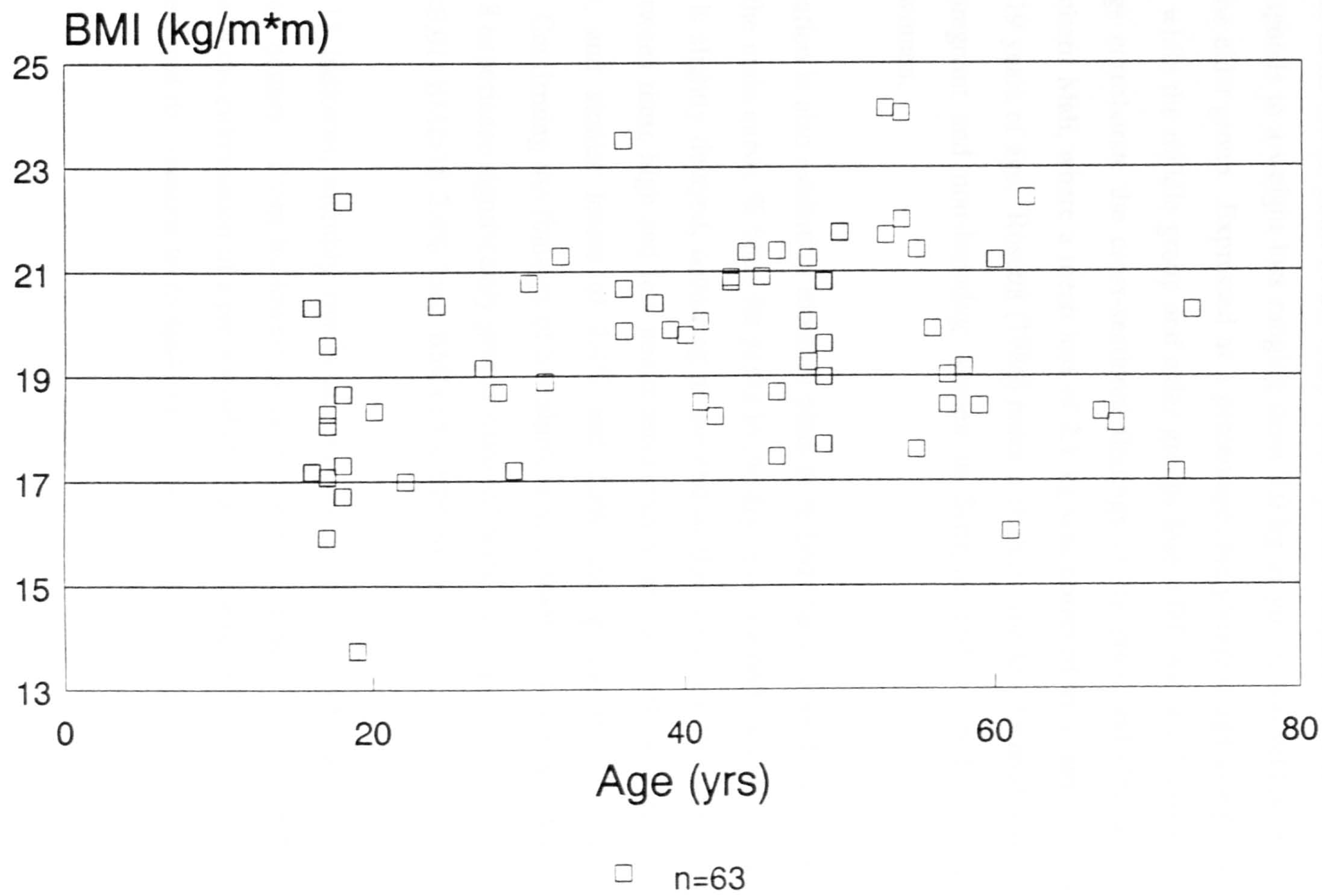
Strongly correlated with BMI, % body fat ($r=0.65$ $p<0.001$) and arm muscle area ($r=0.81$ $p<0.001$) are used as proxy indicators of fat and lean tissue compartments respectively to help evaluate the functional implications of seasonal variations in BMI. Quite clearly, a rainy season decrease in BMI that is mainly the result of lost muscle mass is likely to have more serious repercussions for work-capacity and health than the loss of fat stores.

While a significant rainy season decrease in BMI has been noted in all age groups, the preceding analysis of seasonal changes in % body fat and AMA suggest that most of the change in BMI is due to the loss of fat tissue. The significant loss in % body fat from dry to rainy seasons observed in all age groups was not accompanied by similar seasonal losses in AMA. It therefore might be speculated that for the male population as a whole, seasonal variations in nutritional status are temporary and benign in terms of likely functional consequence.

However, it may be that certain **individuals** within the sample population are at greater seasonal nutritional risk. To test this hypothesis, individuals falling below the cut-off points for Chronic Energy Deficiency (CED) are identified in each season (James et al. 1988). Figure 4.12 plots the distribution of rainy season BMI against age for the male population of Sèbèkoro.

With respect to severe CED (BMI<16 kg/m^2), two teen-aged males fall into this category, and remain there in every season. However, given that these individuals are still growing and their observed activity far exceeds the recommended 1.4*BMR cutoff point, they may be considered false positives. Twelve individuals fall into the moderate CED category (BMI 16-16.9 kg/m^2) in the rainy season which represents an increase of 4 new cases compared to harvest and dry seasons. One of these individuals is a blind and sickly 61 year old whose low BMI may better be explained by the effects of onchocerciasis related morbidity than energy deficiency *per se* (Evans 1989). The remaining eleven cases are healthy and active in agriculture, with estimated rates of energy turnover to predicted BMR of more than 1.4. As such, they are more appropriately classified as falling into the mild category of CED. Thus, in the particular context of the study year, there appears to be a slight seasonal exacerbation in mild forms of CED, however, moderate and severe cases are largely absent from the male population.

Figure 4.12 Male BMI by Age



Sebekoro, Mali

b) Seasonal Variation Among Adult Women

As indicated in Figure 4.13, similar seasonal variations in mean monthly plots of BMI are observed among women; in the dry season (April/May) BMI reaches its apex followed by a gradual decline to its lowest point in the rainy season period (August/September). This drop in BMI corresponds to a weight loss ranging from 2.0 kg in young and middle age groups, to 2.2 kg in the elder group. Expressed as a percentage, the youngest age group loses 3.7% body weight, while the middle group and elder groups lose 4.0% and 4.7% respectively. These findings corroborate the cross-sectional findings of Benefice and Chevassus-Agnes (1985) in southern Mali, where a mean loss of 2.1 kg was observed in a sample of Bamana women over 19 years of age. Rosetta (1986) notes a slightly smaller seasonal loss of 1.7 kg among non-pregnant and non-lactating women in Senegal, and a 1.6 kg loss in post-menopausal women.

Seasonal variation is also evident in monthly plots of % body fat (Figure 4.14). Resembling the shape of the male curve, % body fat peaks in the dry season month of April, however its lowest point is slightly delayed, occurring at the end of the rainy season in October. The difference between these high and low points represents a loss of 3.5% body fat among the young group, and similar losses of 2.4% and 2.5% among middle and elder groups respectively. Confirming the findings of Schultink et al. (1990) in Benin, Sèbèkoro women with BMIs>18 experience significantly greater seasonal body fat loss compared to those with BMIs<18 ($p<0.01$: BMI>18 2.4% loss; BMI<18 1.13% loss).

As Figure 4.15 indicates, monthly trends in arm muscle area (AMA) do not reveal any obvious season pattern. From its lowest point in the harvest period (October/November) which represents the culmination of a particularly harsh soudure season, AMA rises gradually through harvest and dry seasons to its apex in the rainy season.

Figure 4.13 BMI by Month of Women According to Age Group

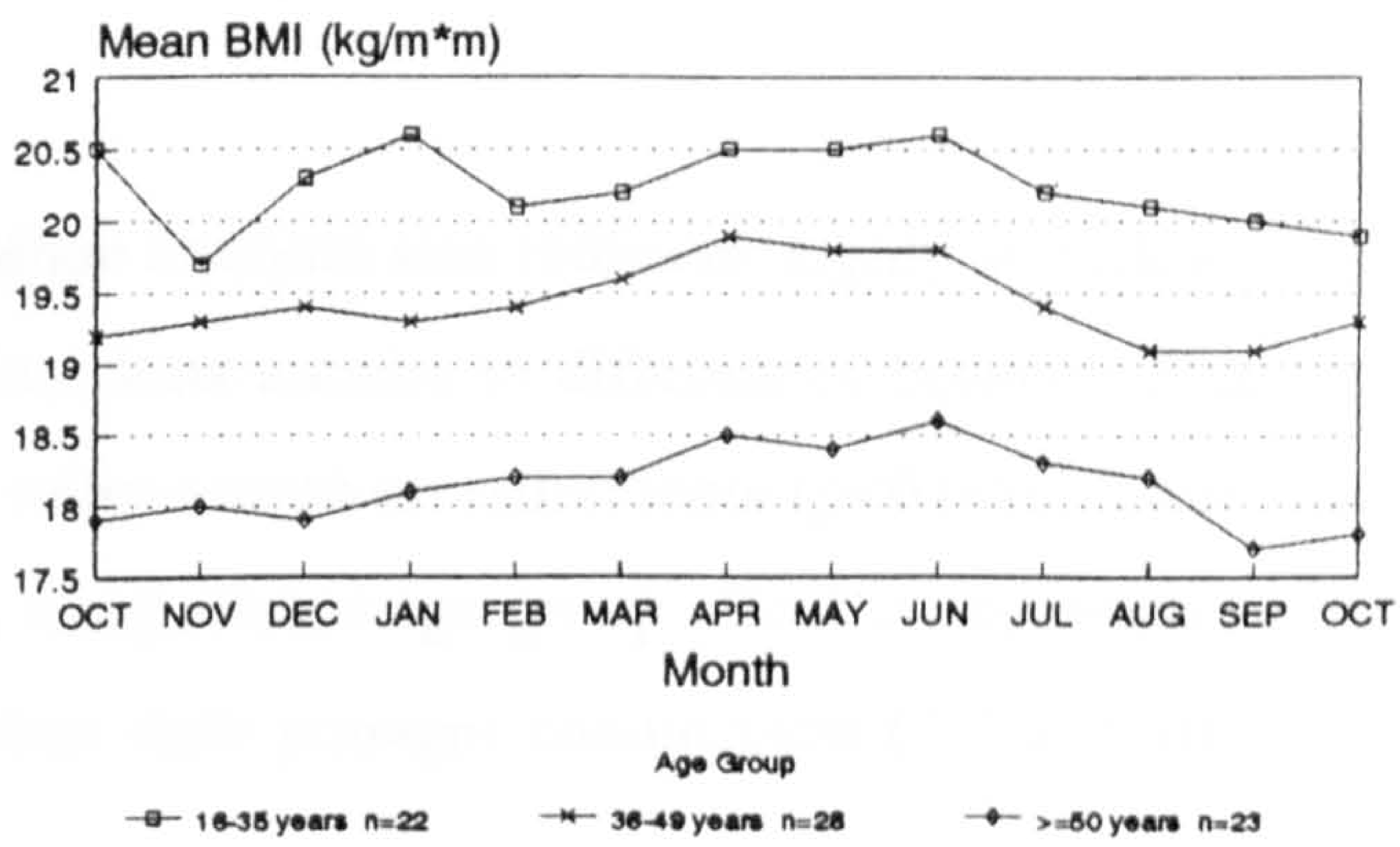


Figure 4.14 Percentage Body Fat by Month of Women According to Age Group

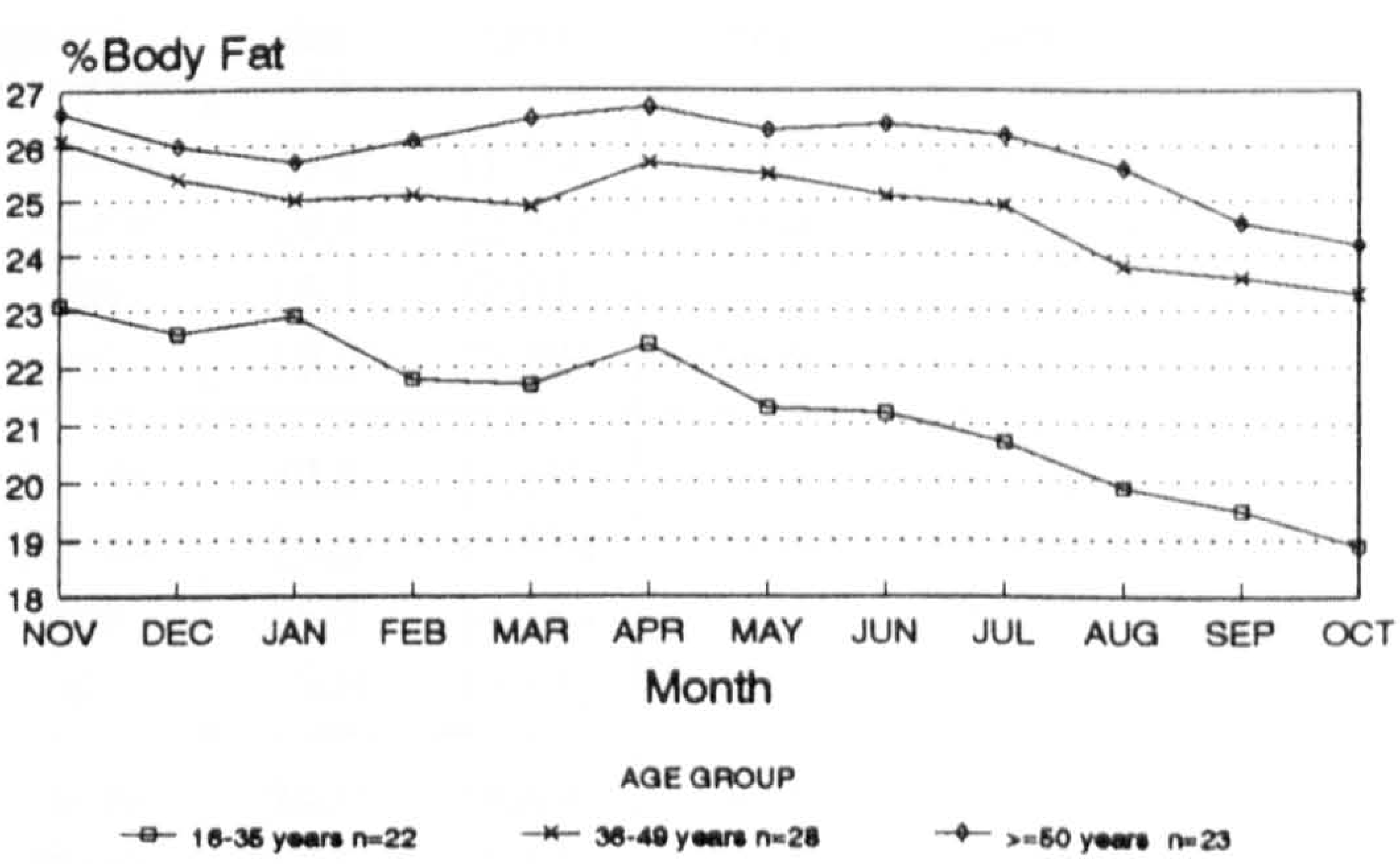
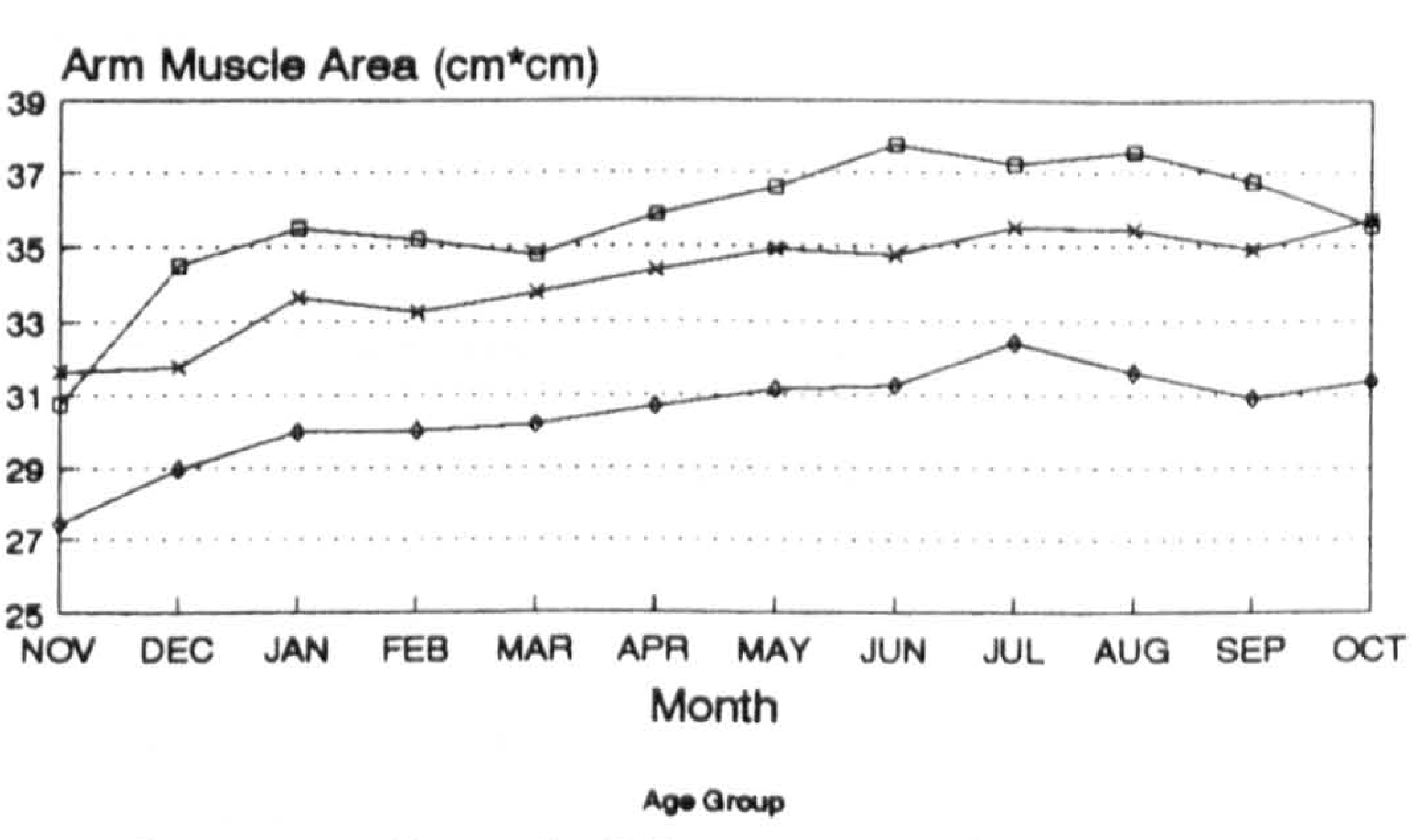


Figure 4.15 Arm Muscle Area by Month of Women According to Age Group



Sebekoro, Mali

As shown in Table 4.10, repeated measures analysis of variance reveals significant seasonal variations in BMI in all three age groups (young and elder p<0.01; middle p<0.0001). Univariate analysis attributes the highly significant results observed in the middle age group to differences between harvest and dry season BMI (f=11.24 p<0.01), and the average of these measures compared to rainy season BMI (f=11.64 p<0.01). No significant age group effect is detected.

Repeated multivariate analysis also indicates highly significant seasonal variations in % body fat which univariate tests ascribe to differences between average harvest and dry season % body fat and low rainy season measurements (p<0.0001 for all age groups). Unlike the male sample, however, a significant age group effect is apparent (p<0.0001); elder women having greater body fat than their younger counterparts (Table 4.10)[15].

Table 4.10 Seasonal Anthropometric Variation in Sèbèkoro Adult Women by Age Group
16-35 years n=22; 36-49 years n=28; 50+ years n=23

indicator	group	har	(sd)	dry	(sd)	rainy	(sd)	I	II
BMI (kg/m^2)	16-34	20.2	(1.99)	20.5	(1.81)	20.1	(1.85)	**	
	35-49	19.4	(2.50)	19.8	(2.50)	19.2	(2.55)	****	
	50+	18.1	(2.01)	18.5	(2.13)	18.1	(1.97)	**	
	all	19.3	(2.33)	19.6	(2.32)	19.1	(2.29)	****	N/S
body fat (%)	16-34	22.8	(4.19)	21.7	(3.16)	19.8	(3.34)	****	
	35-49	25.6	(5.37)	25.4	(5.00)	23.8	(5.33)	****	
	50+	26.3	(4.10)	26.6	(3.44)	25.2	(3.33)	****	
	all	25.0	(4.83)	24.7	(4.46)	23.1	(4.71)	****	****
AMA (cm^2)	16-34	34.0	(4.89)	36.4	(4.90)	36.9	(4.79)	****	
	35-49	32.6	(5.57)	34.3	(5.48)	35.3	(5.81)	*****	
	50+	28.9	(5.29)	31.0	(5.52)	31.7	(6.05)	***	
	all	31.8	(5.61)	33.9	(5.68)	34.6	(5.92)	****	N/S

Repeated measures analysis of variance: I seasonal effect II age group effect N/S not significant
** p<0.01 **** p<0.0001

Seasonal variations in AMA are also more striking in the female sample; highly significant seasonal differences are apparent in all age groups (p<0.0001). Univariate f-tests indicate

[15]The later adult years are characterized by a decline in lean body mass in both sexes, and an increase in body fat which accounts for a fall in BMR relative to body size (Forbes and Reina 1970).

significant increases in AMA from harvest to dry seasons (f=96.53 p<0.0001) in addition to further increases between average harvest and dry season measurements and rainy season AMA (f=76.18 p<0.0001).

The likely functional impact of seasonal reductions in BMI during the rainy season period may be speculated by considering the relative impact of seasonality on fat and lean tissue compartments. Correlated with BMI (r=0.49 p<0.001), a significant loss of % body fat occurs in the rainy season in all age groups[16]. However, AMA, which represents a proxy indicator of the lean tissue compartment of BMI (r=0.69 p<0.001), does not seem to be compromised. In fact, significant gains in AMA in both the dry and rainy seasons are recorded in all age groups. Although it can only be conjectured, this temporal increase in AMA might represent the progressive recuperation of lean tissue depleted during the harsh soudure season the year previous, or alternatively, it could be due to measurement error.

Given the apparent preservation of lean tissue, these results seem to suggest that seasonal fluctuations in nutritional status have no functional implications for the non-pregnant female population of Sèbèkoro. Overlooked in the examination of population means, however, are the possible consequences of seasonal variations in nutritional status for individuals already 'at-risk', be they lactating mothers or women with low BMI's.

Closer inspection of the distribution of female BMI by age in the rainy season (Figure 4.16) reveals a large number of women at the lower end of the risk curve relative to the male sample: 27% of the female sample have BMI's under 17.0 kg/m^2 compared to 8% in the male sample. Furthermore, within the female sample, women in their post-reproductive years (46 years+) account for 60% of BMI's under 17.0 kg/m^2 but only 40% of the female population.

Using the methodology proposed by James et al. (1988), four women in the sample appear to fit the criteria for severe CED (BMI<16 kg/m^2). Three of the four women have BMI's

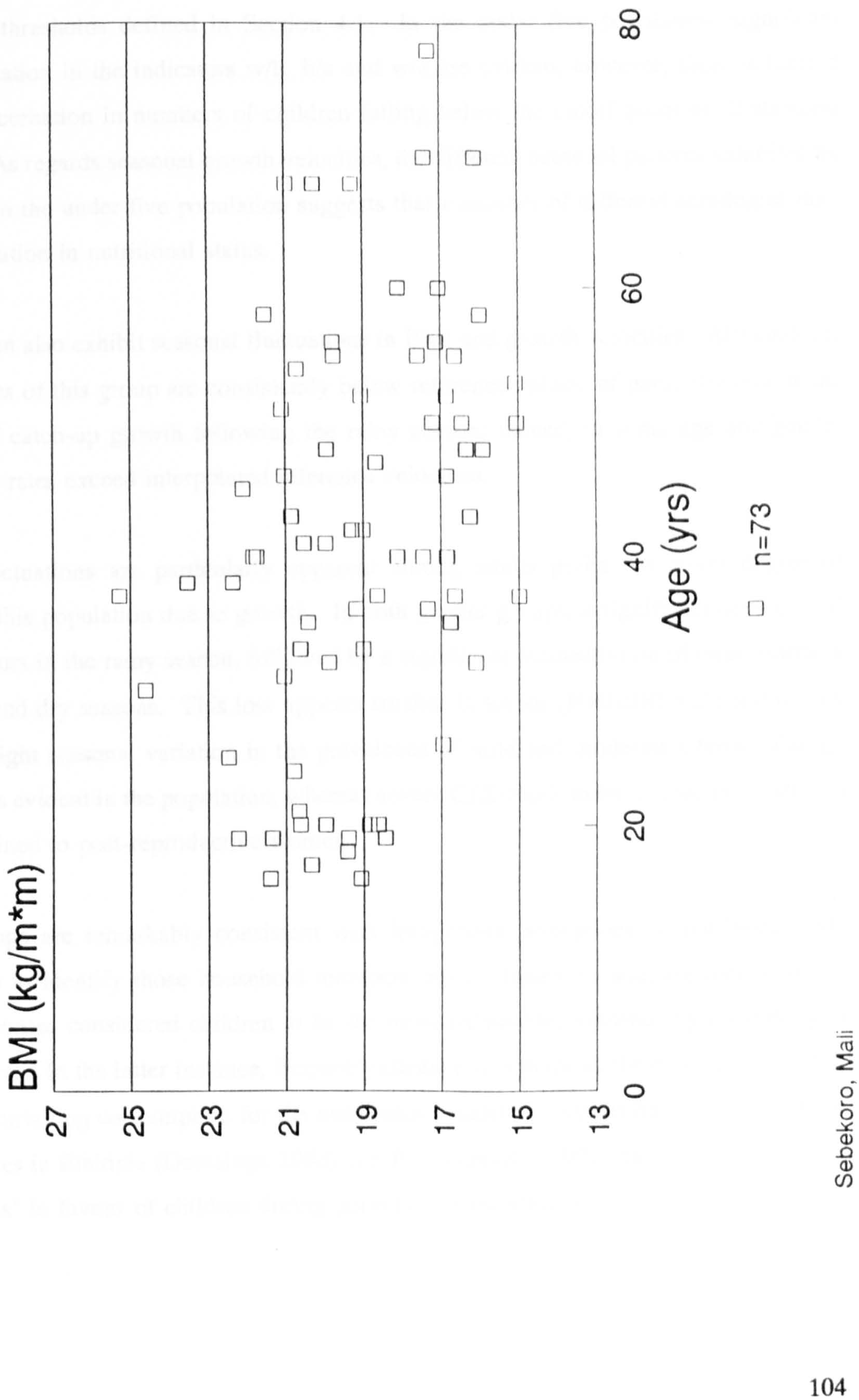
[16]It is possible that seasonal fat loss may be of far greater functional significance in pregnant women who have to support the needs of a growing fetus in addition to meeting their own energy requirements. In a study of pregnant women in the Gambia, Lawrence et al. (1987), argue that the mobilization of adipose stores is central to reducing the energy costs of pregnancy to 150 kcal/day compared to 300 kcal for European women.

below the 16 kg/m^2 cut-off point in every season. All are sickly and inactive, with a ratio of energy turnover to predicted BMR of less than 1.4.

In the rainy season, a total of thirteen women have BMI's which fall into the moderate category of CED (BMI 16-16.9 kg/m^2); an increase of two cases over previous seasons. However, only three women have activity levels below the 1.4* predicted BMR cut-off point used to screen for false positive diagnoses. One is very elderly, and two are chronically ill (tuberculosis and asthma). The remaining 10 women in this category are reasonably healthy and active and may therefore be classified in the mild category of CED.

It appears, therefore, that CED in its severe and moderate forms is present in the female population in Sèbèkoro. However, its chronic nature suggests a more complex aetiology than is offered by seasonal analysis. Mainly affecting women in their post-reproductive years, CED may represent the outcome of years of child-bearing and demanding physical labour.

Figure 4.16 Female BMI by Age



4.5 Comparative Nutritional Risk of Age and Gender Groups in Sèbèkoro

The preceding assessment of seasonal nutritional risk among age and gender groups in the population of Sèbèkoro indicates significant variation in nutritional indicators, but little which exceeds the thresholds defined in Section 4.1. In the under five population, significant seasonal variation in the indicators w/h, h/a and w/a are evident, however, there is limited seasonal exacerbation in numbers of children falling below the cutoff point of -2 standard deviations. As regards seasonal growth velocities, the different seasonal patterns exhibited by age cohorts in the under five population suggests that a number of different aetiologies may underlie variation in nutritional status.

Older children also exhibit seasonal fluctuations in BMI and growth velocities.. Although the growth curves of this group are consistently below reference values, of particular note is the rapid rate of catch-up growth following the rainy season; indeed, in some age and gender groups these rates exceed interpolated reference velocities.

Seasonal fluctuations are particularly apparent among adults given the lesser degree of variation in this population due to growth. In both gender groups, a significant depletion of body fat occurs in the rainy season, followed by a significant reconstitution of these stores in the harvest and dry seasons. This loss appears smaller in leaner (BMI<18) male and female samples. Slight seasonal variation in the prevalence of mild and moderate Chronic Energy Deficiency is evident in the population, whereas severe CED tends to be chronic in nature and largely confined to post-reproductive women.

These findings are remarkably consistent with indigenous perceptions of nutritional risk. When asked to identify those household members most affected by soudure food scarcity, 41% of responses considered children to be the most vulnerable, followed by the elderly in 25% of replies. In the latter instance, frequent reference was made to the cultural practice of the elderly curtailing consumption for the nutritional benefit of younger household members. Recent studies in Ethiopia (Dessalegn 1988) and Peru (Leonard 1991) have also documented a 'social bias' in favour of children during periods of food scarcity.

In sum, given the brevity and relatively mild degree of seasonal nutritional risk experienced by the different age and gender groups in the population, it unlikely that any measurable dysfunction can be attributed to short-term seasonal variation alone. Indeed, in the case of adults, it might be argued that the moderate loss of body weight represents a biological food security strategy, as decreased body size lowers net BMR during a period of high energy expenditure and food scarcity. It should be noted, however, that the year of measurement occurred in the wake of a reasonable harvest. The degree of seasonal nutritional risk in the context of a severe food shortage, or successive food shortages may be of greater concern.

CHAPTER V: DETERMINANTS OF SEASONAL CHANGE IN NUTRITIONAL RISK

5.0 Introduction

The previous chapter revealed widespread seasonal variations in nutritional status using anthropometric indicators as proxy measures of nutritional risk. In particular, it noted an amelioration in the growth velocities of children, and the reconstitution of fat tissue stores in adults during the harvest and dry seasons, followed by a deceleration in child growth, and the loss of adult body fat in the rainy season. What the analysis of anthropometric indicators fails to identify are the determinants of seasonal variations in energy balance, and ultimately the degree of risk they imply.

Furthering the hypotheses developed in Chapter IV, this chapter considers age and gender group differences with respect to the likely determinants of seasonal variations in nutritional risk, and comments generally on the functional implications of this variation. Of the myriad possible determinants of nutritional risk, three hypotheses are entertained as to why the rainy season represents a period of negative energy balance for age and gender groups within the study population[1]. First, it may be hypothesized that household food supply and availability are severely curtailed in the rainy season resulting in insufficient energy intake. Alternatively, intense rainy season activity may account for levels of expenditure that exceed regular energy intake. Thirdly, it may be that elevated morbidity patterns typically associated with the rainy season precipitate weight loss due to their adverse effect on activity, appetite and absorption.

Organized about these three hypotheses, Section 5.1 of this chapter explores seasonal modifications in household food consumption, Section 5.2 considers seasonal variations in energy expenditure and Section 5.3 examines seasonal morbidity patterns. In Section 5.4, the synergistic interactions between seasonal patterns of food consumption, energy expenditure and morbidity are considered in an attempt to assess the degree of nutritional risk experienced seasonally by age and gender groups within the population. Repeated measures analysis of

[1] Among this myriad of possible determinants are genetic variations in growth (Payne 1990), and proximate household factors such as household size, birth order, birth interval and sibling sequence (Harriss et al. 1990).

variance is used to detect the significance of variations in seasonal variables throughout the chapter.

5.1 Seasonal Food Consumption

Inspection of three-day food frequency data reveals seasonal variations in the variety, type, quality and quantity of food consumed by Sèbèkoro households. Three main meals are generally prepared although this may vary depending on the degree of cereal availability in the household or the 'day of the week effect' of Sunday markets or other social events when household members eat elsewhere. In times of dearth, the morning porridge may be omitted, the mid-day meal replaced by porridge, or wild foods used to supplement or replace cereal rations[2]. A fourth meal is sometimes served in the late afternoon to children and others depending on cereal stocks, the appetite of households members, and the time constraints of women responsible for meal preparation.

Table 5.0 presents the frequency of daily meals as a percentage of the total number of consumption days monitored in each season. Most striking is the widespread omission of the afternoon meal in the harvest period compared to other seasons.

Table 5.0 Frequency of Daily Meals Expressed as a Percentage of the Total Number of Monitored Consumption Days by Season: n=198 in every season

meal	Bamana	harvest	dry	rainy
morning	*daraka*	98	98	100
mid-day	*tilerofana*	91	95	95
afternoon	*wulafana*	11	50	35
evening	*surofana*	100	99	100

[2] While in the past animist Bamana were known to brew millet beer, this practice has largely been abandonned due to the combined influences of persistent drought and Islam.

Considering data on the types of meals consumed seasonally (Table 5.1), it is quite likely that the frequency with which energy dense *nyinikini* is prepared makes an additional meal unnecessary in the harvest season.

Table 5.1 Frequency of Daily Meal Types Expressed as a Percentage of the Total Number of Meals Consumed in Each Season

meal	description	harvest n=595	dry n=678	rainy n=655
	MORNING or AFTERNOON MEAL			
seri	liquid porridge made with grains of sorghum or millet	33	35	32
moni	liquid porridge made with fermented balls of millet flour	2	9	7
	MID-DAY or EVENING MEAL			
to	stiff porridge of millet flour with glutinous ochra or baobab sauce	20	24	26
nyinikini	stiff porridge made with grains of sorghum served with groundnut sauce	33	22	25
basi	steamed millet couscous served with groundnut sauce	8	8	7
	OTHER			
dege	steamed millet balls served with soured milk;			
	rice and sauce; cowpeas; squash; bambara groundnuts; potatoes	4	2	3

The availability of sauce ingredients also differs seasonally (Table 5.2). In the harvest season, groundnuts form the base of most sauces while groundnut income permits the purchase of diverse other condiments including tomato, dried fish, sour milk and dried ochra (*Hibiscus esculentus*).

In the dry season, groundnut sauces are replaced by those based on dried baobab leaves (*Adansonia digitata*) flavoured with *datu* and *soumbala*[3]. As dried condiments become increasingly scarce in the rainy season, wild leaves such as *sofon, lèlè* and *kolofara* provide the glutinous base for rainy season sauces, while shea butter extracted from the fruit kernel of shea-nut tree (*Butyrospermum parkii*) represents a seasonally important fat source.

Table 5.2 Frequency of Daily Condiment Consumption Expressed as a Percentage of the Total Number of Monitored Consumption Days by Season: n=198 days

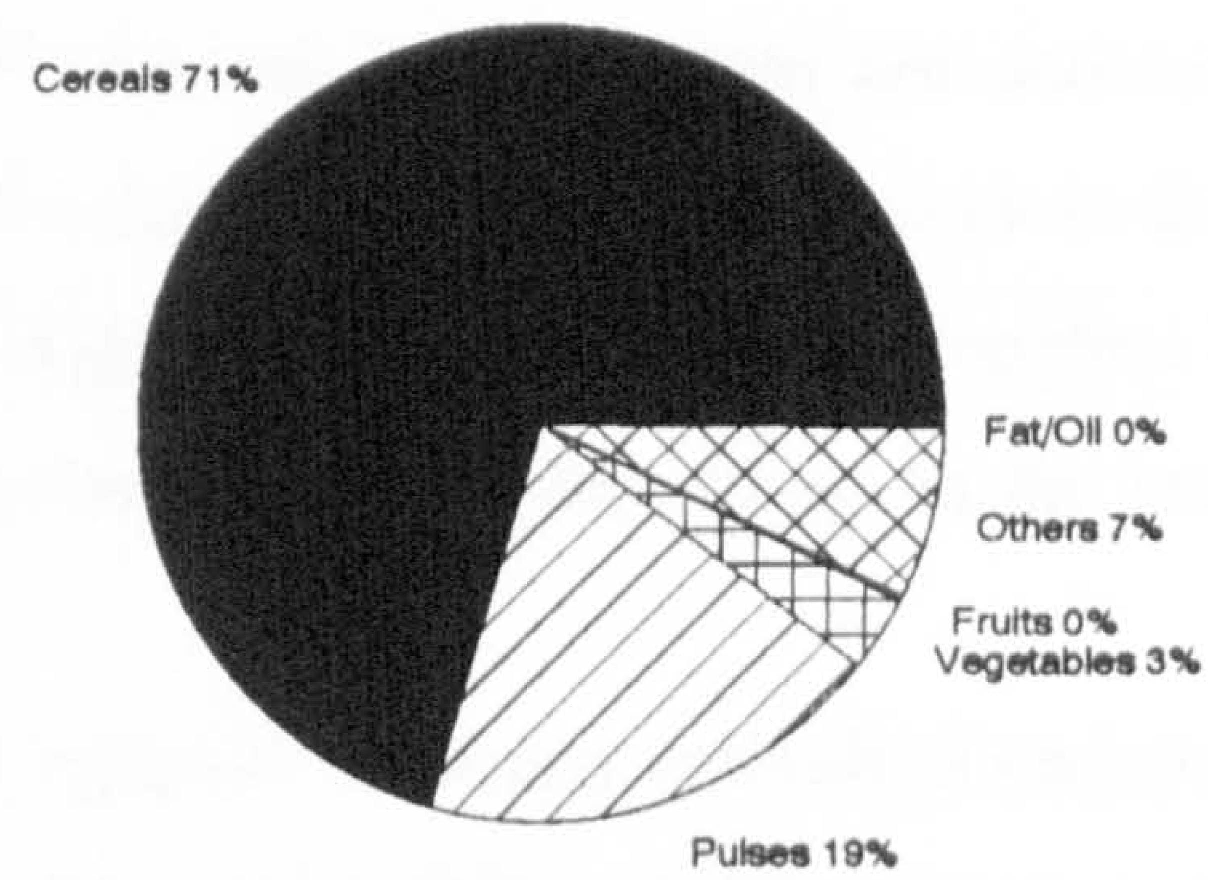
condiment	Bamana name	harvest	dry	rain
groundnut butter	*tiga dege*	92	72	73
sorrel	*datu*	77	81	86
nere	*soumbala*	31	33	46
shea butter	*si*	3	11	20
salt	*kogo*	99	100	99
red pepper	*foronton*	57	51	30
stock cubes	*maggi*	80	83	88
dried fish	*jege*	64	51	30
fresh meat/fish	*sogo/jege*	9	20	7
fresh/sour milk	*nono keme/kumu*	55	29	32
onion	*jaba*	40	42	45
tomato	*tamati*	49	35	3
ochra	*gan*	56	21	4
sorrel leaves	*da kumu*	15	7	6
baobab leaves	*n'sira*	38	77	89
wild leaves	*nabulu*	1	5	37

a) Seasonal Energy Intake

Weighed intake data, gathered twice in each seasonal period, permits a more detailed analysis of variation in Bamana diet. Net energy intake is based on the snacks and meals consumed by household members, and adjusted to take into account food gifts given and received by the household.

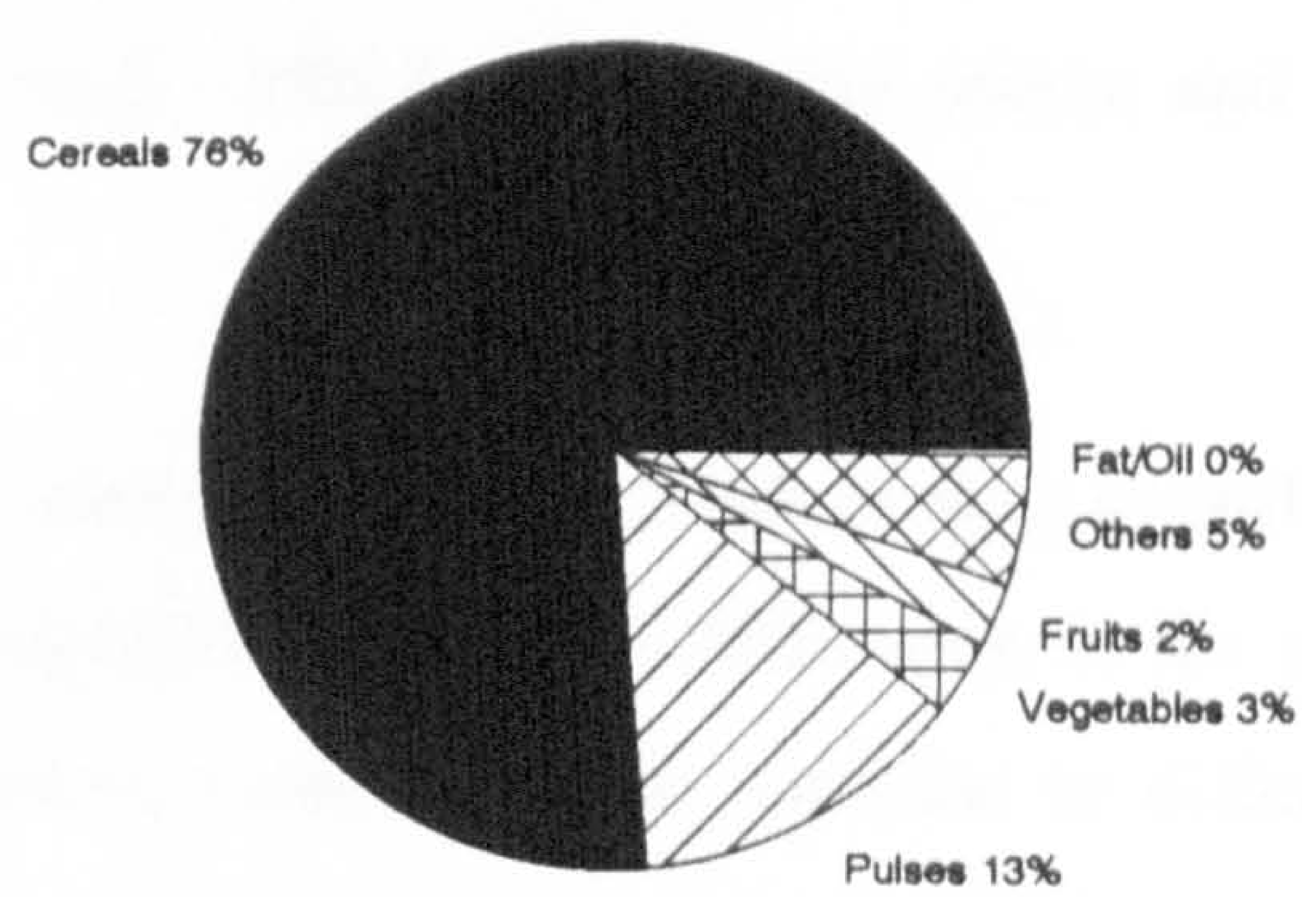
[3]*Soumbala* originates from the seeds of the nere or African locust tree (*Parkia biglobosa*). A labour intensive process of pounding, rinsing, fermentation and drying is required to transform the seed to its edible form. Seeds of the cultivated sorrel plant (*Hibiscus sabdariffa*) are processed in a similar manner to yield the condiment *datu.*

Figure 5.0a Energy Intake from Main Food Groups
in Harvest Season (kcal/cu)



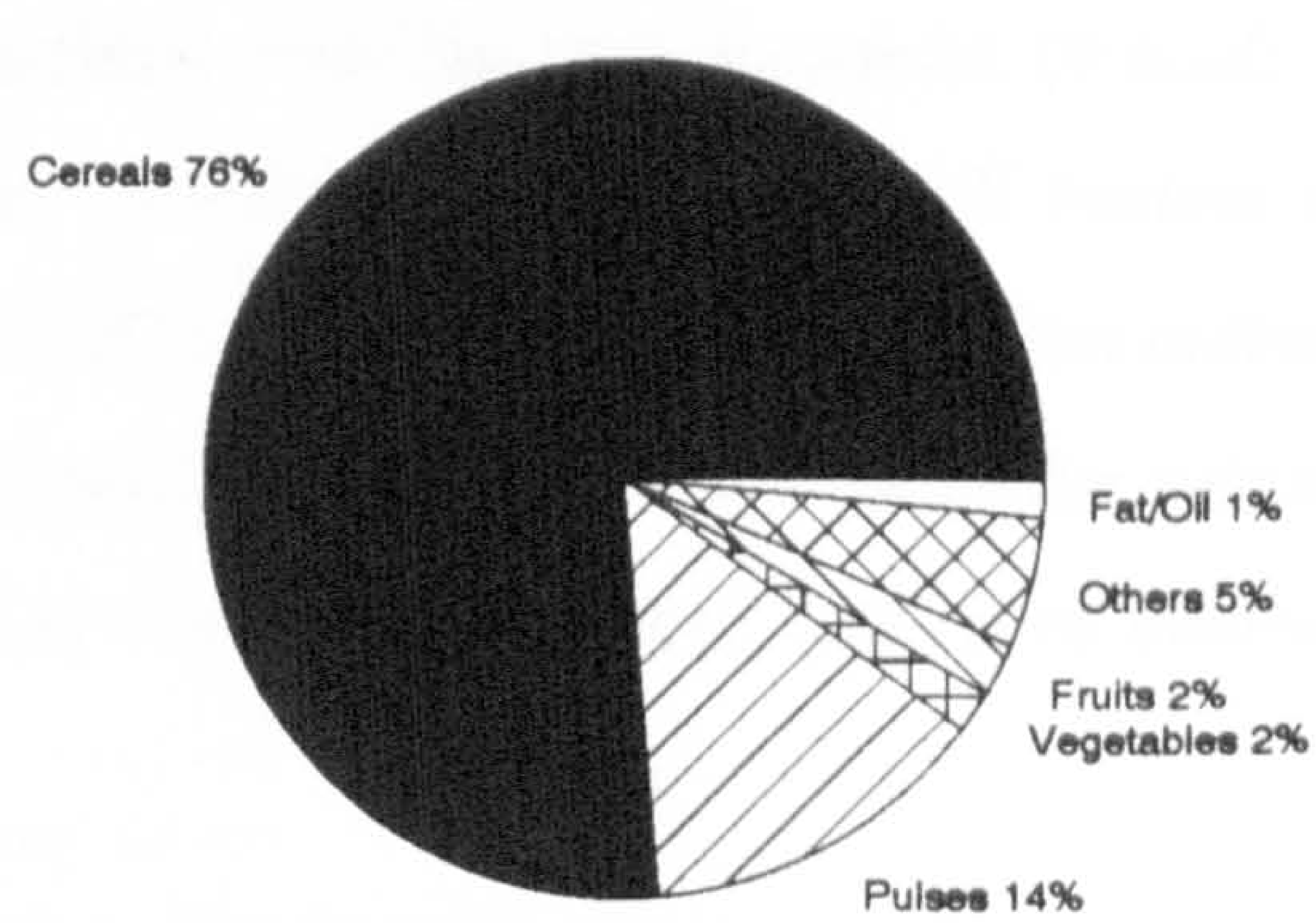
mean= 2795 kcal/cu

Figure 5.0b Energy Intake from Main Food Groups
in Dry Season (kcal/cu)



mean= 2471 kcal/cu

Figure 5.0c Energy Intake from Main Food Groups
in Rainy Season (kcal/cu)



mean= 2735 kcal/cu

Sebekoro, Mali

Intake figures are expressed per consumption unit to permit inter-household and inter-seasonal comparison[4]. Because the consumption unit expresses the energy and nutrient intake in terms of an adult male equivalent, the risk of inadequacy for age and gender groups within the household may only be speculated.

Using this method, final seasonal intake figures are derived: 2795 kcal/cu in the harvest season, 2471 kcal/cu in the dry season, and 2735 kcal/cu in the rainy season. As Figures 5.0 a b and c illustrate, the large part of this energy is supplied by cereals (71 to 76%), and a further 13 to 19% is provided by pulses depending on the season.

Summarized in Table 5.3, repeated measures analysis of variance indicates significant seasonal variations in energy intake ($f=6.23$ $p<0.01$). Differences between harvest and dry seasons are largely explained by the seasonal availability of groundnuts which provide 528 kcal in the harvest season but only 327 kcal in the dry season ($f=39.87$ $p<0.0001$). By contrast, differences in dry and rainy season energy intake are mainly due to a significant increase in energy provided by cereals: 1882 kcal in the dry season and 2088 kcal in the rainy season ($f=13.52$ $p<0.001$).

Other food groups are relatively minor in terms of their contribution to overall energy intake. Most remarkable are significant seasonal differences in the energy provided by vegetables ($f=15.58$ $p<0.0001$) which univariate tests attribute to differences between lower intakes recorded in the rainy season (45 kcal) compared to higher average harvest (86 kcal) and dry (71 kcal) season intakes ($f=26.97$ $p<0.0001$).

In contrast, energy provided by fruit is significantly greater in both dry (61 kcal) and rainy (57 kcal) seasons, compared with the harvest season (9 kcal; $f=26.24$ $p<0.0001$). With the exception of *n'tombolo* (*Ziziphus mauritiana*), small berries which ripen at the end of the harvest season, and the cultivated mango tree (*Mangifera indica*) which yields fruit in the dry season months of April and May, wild fruits such as the *zaban* (*Parinari exclas*), *dukura* or bush mango (*Cordyla africana*), wild grapes known as *bembe* (*Lannea acida*), *sebe* of the

[4]See Chapter II for a description of household food consumption methods. The food composition table used for nutrient analysis is found in Appendix II, and the derivation of consumption units is presented in Appendix V.

sahelian raphia palm (*Borassus aegyptica,*) and shea-nut fruit (*Butyrospermum parkii*) ripen with the onset of the rainy season in late June. Also of note is the contribution of milk, roots/tubers ($p<0.05$), and sugar ($p<0.0001$) to harvest season diet relative to dry and rainy seasons, and the contribution of fat energy supplied by shea-nut butter in the rainy season ($p<0.01$). No significant seasonal differences are evident in other food group categories including meat/fish, and prepared foods.

Table 5.3 Seasonal Energy Intake from Main Food Groups in Sebèkoro: n=33 households

	mean daily energy intake by season kcal/cu (sd)			
food group	harvest	dry	rainy	I
net energy	2795 (428)	2471 (391)	2735 (443)	**
cereals	1974 (359)	1882 (324)	2088 (332)	**
tubers	13 (27)	5 (26)	0.2 (1)	*
pulses	528 (193)	327 (215)	370 (226)	****
vegetables	86 (44)	71 (76)	45 (25)	****
fruits	6 (14)	60 (63)	57 (45)	****
meat/fish	21 (29)	30 (43)	26 (55)	N/S
milk	30 (36)	16 (34)	18 (22)	N/S
fat/oil	4 (9)	7 (16)	38 (60)	**
sugars	25 (13)	9 (13)	7 (12)	****
others	4 (2)	6 (4)	5 (3)	*
prepared[a]	105 (167)	57 (102)	79 (152)	N/S

I Repeated measures analysis of variance: N/S not significant * $p<0.05$ ** $p<0.01$ *** $p<0.001$ **** $p<0.0001$
[a] prepared foods are generally purchased from the market or from women in the village

b) Seasonal Protein Intake

Summarized in Table 5.4, repeated analysis of variance also identifies significant seasonal differences in net protein intake (f=14.24 p<0.0001). Univariate analysis attributes most of this significance to differences between harvest (92.5 g) and dry (76.8 g) season measures (f=29.37 p<0.0001) while rainy season protein intake lies in between (81.2 g).

Table 5.4 Seasonal Protein Intake from Main Food Groups in Sèbèkoro: n=33 households

	mean daily protein intake by season g/cu (sd)			
food group	harvest	dry	rainy	I
net protein	92.5 (16.9)	76.8 (18.7)	81.2 (22.6)	****
digestible protein*	78.6 (14.4)	65.3 (15.9)	69.0 (19.2)	****
cereals	57.5 (9.8)	50.7 (10.2)	54.9 (11.8)	**
tubers	0.2 (0.4)	0.1 (0.4)	trace	*
pulses	25.6 (10.7)	15.8 (10.7)	18.0 (11.3)	****
vegetables	3.7 (1.9)	3.8 (5.6)	2.2 (1.2)	****
fruits	0.1 (0.3)	0.6 (0.7)	1.2 (0.9)	****
meat/fish	3.3 (4.4)	4.4 (6.2)	3.4 (6.8)	N/S
milk	1.6 (1.9)	0.8 (1.7)	0.9 (1.1)	N/S
fat/oil	--	trace	trace	N/S
sugars	--	--	--	--
others	0.4 (0.3	0.5 (0.3)	0.5 (0.3)	*

I Repeated measures analysis of variance: N/S not significant * p<0.05 ** p<0.01 *** p<0.001 **** p<0.0001
* corrected for the digestibility of a high fibre diet: (g protein*0.85)

Figure 5.1a Protein Intake from Main Food Groups in Harvest Season (g/cu)

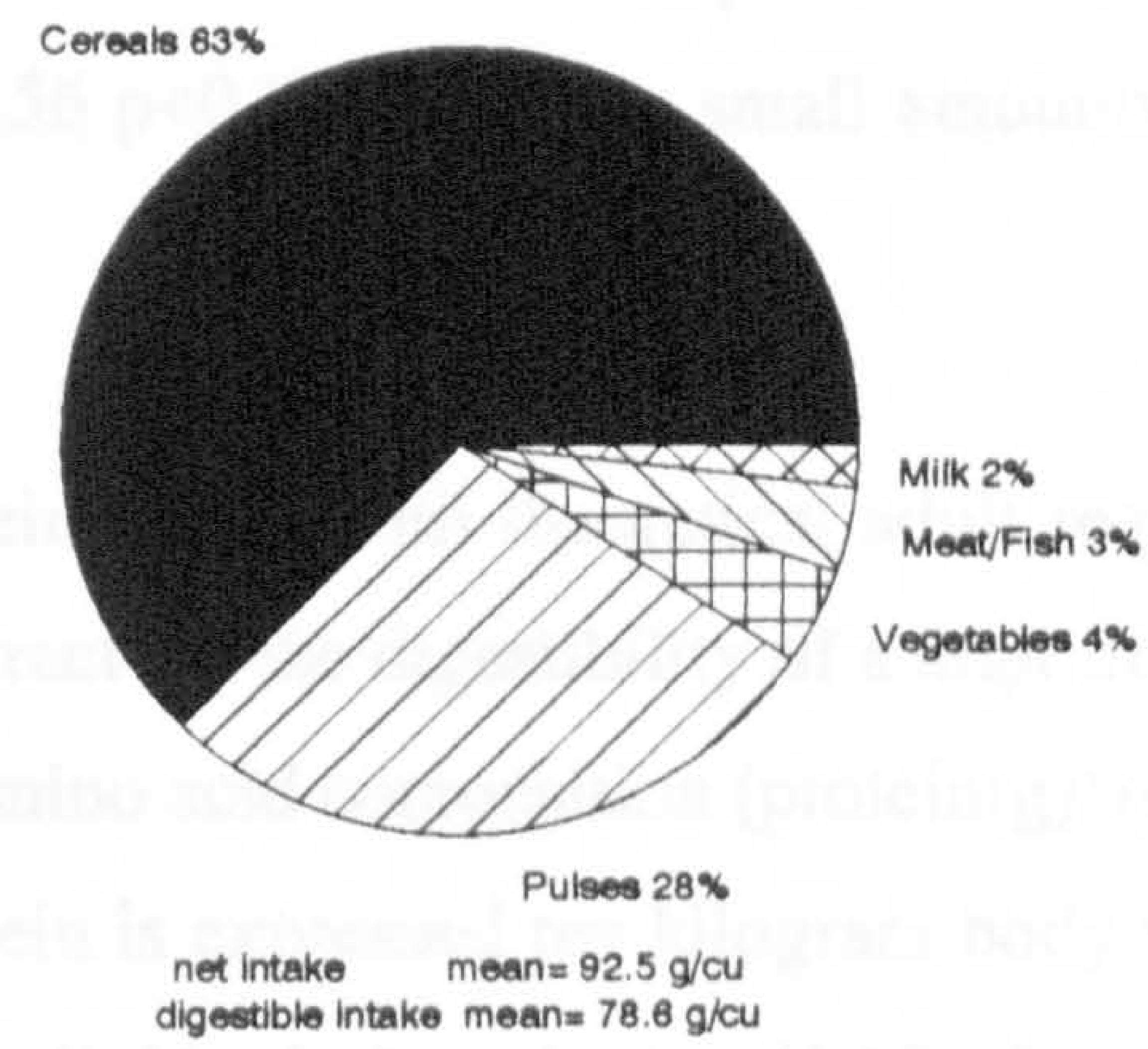


Figure 5.1b Protein Intake from Main Food Groups in Dry Season (g/cu)

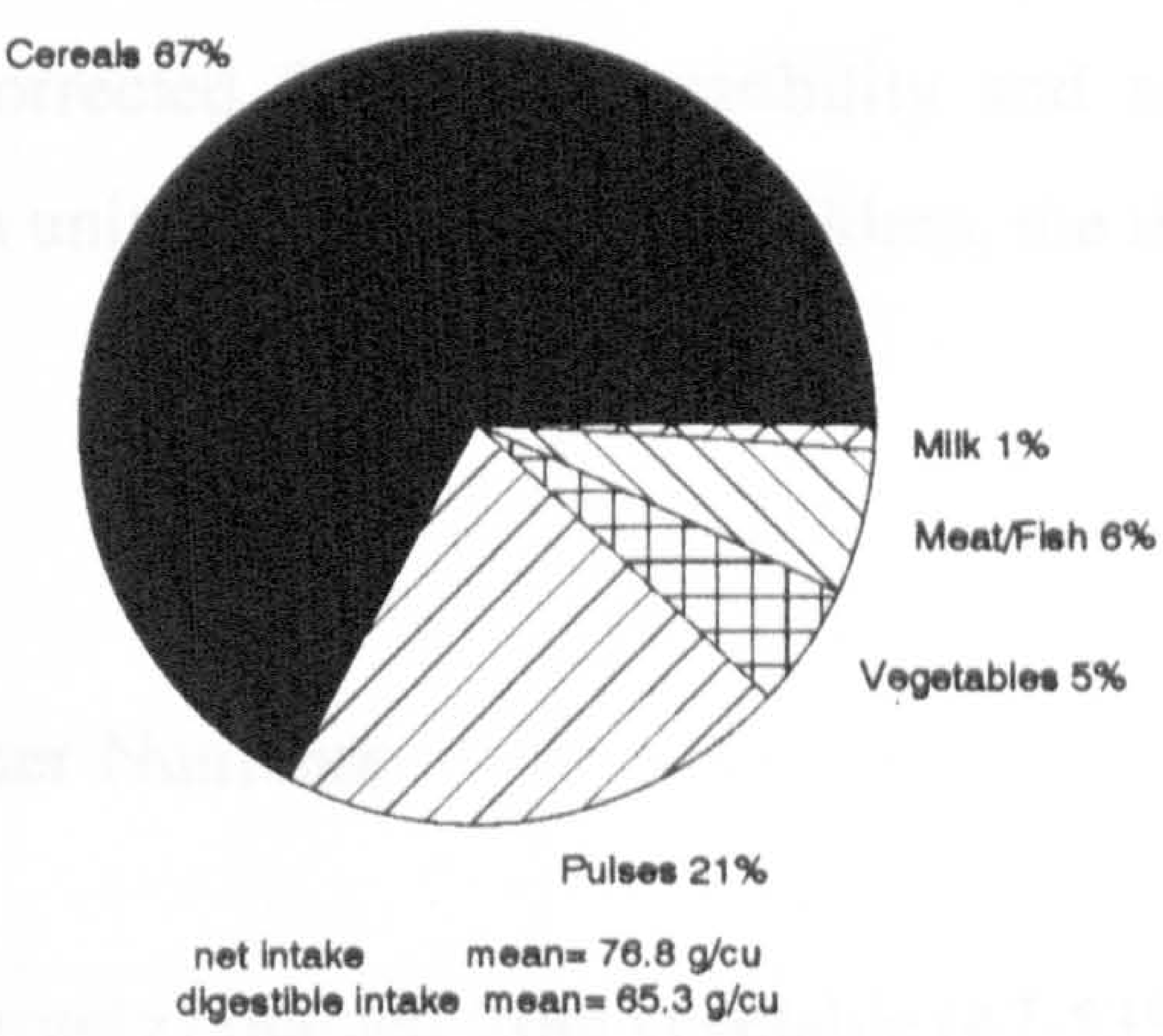
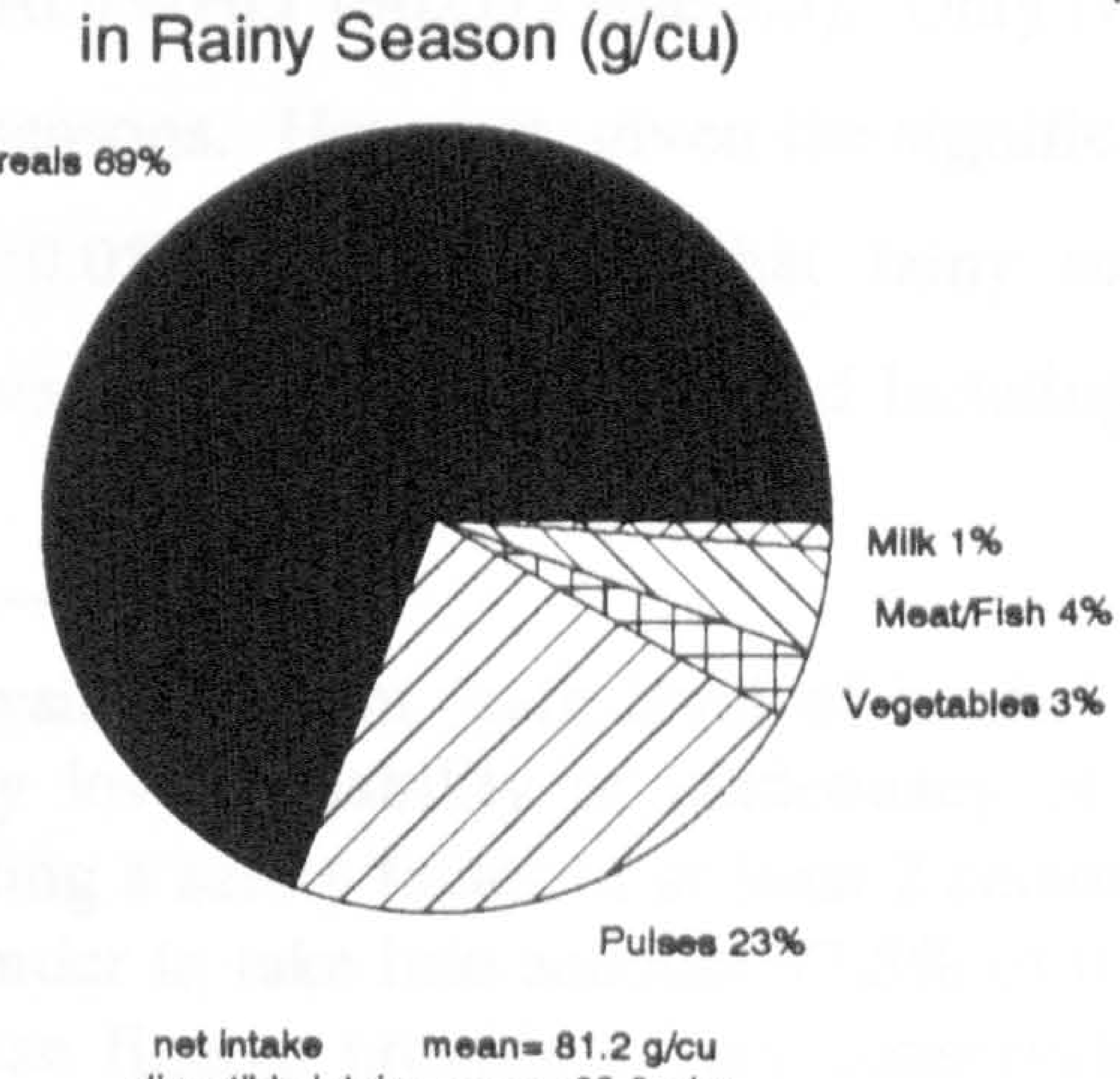


Figure 5.1c Protein Intake from Main Food Groups in Rainy Season (g/cu)



Sebekoro, Mali

As Figures 5.1 a b and c indicate, most protein is provided by cereals (62-69%). Significant seasonal variations in protein intake from cereal sources ($f=5.97$ $p<0.01$) are mainly due to differences between harvest (57.5 g) and dry (50.7 g) season intakes ($f=9.39$ $p<0.01$). The availability of newly harvested pulses also contributes to seasonal variation. Pulses supply 25.6 g of total protein in the harvest season compared to 15.8 g in the dry season and 18.0 g in the rainy season ($f=18.56$ $p<0.0001$). Very small amounts of protein are found in other food groups.

To compare utilizable protein intake with theoretical adult requirements, net protein figures must first be adjusted to correct for the digestibility of a high fibre diet (protein(g)* 0.85), and in the case of children, its amino acid composition (protein(g)*(0.85)*0.67 for a lysine limited diet). When digestible protein is expressed per kilogram body weight (corrected protein/59.0 kg), harvest (1.33 g/kg), dry (1.11 g/kg), and rainy (1.17 g/kg) season intakes satisfy the safe level of intake for adults (0.75 g/kg) proposed by FAO/WHO/UNU (1985)[5]. In only one household in the dry season does digestible protein fall slightly below this safe level. Even when protein intake is corrected for both digestibility and amino acid composition, and multiplied by consumption units corresponding to children, the risk of inadequacy is very low.

c) Seasonal Intake of Other Nutrients

Calcium intake, which is largely obtained from vegetable (47-53%), cereal (20-26%) and pulse (15-19%) food groups, also satisfies a safe level of intake of 400-500 mg proposed for moderately active adults (FAO/WHO 1962) (Table 5.5). Only two households fall below this range in the dry and rainy seasons. However, given the significance of seasonal variation in calcium intake ($f=4.27$ $p<0.05$), it is possible that rainy season intake (613.3 mg) is insufficient to meet the elevated needs of pregnant and lactating women (1000-1200 mg).

[5] Throughout this analysis, the term 'safe level of intake' refers to a level of nutrient intake which carries a very low probability of inadequacy or risk of deficiency. This is accomplished by incorporating a safety factor of at least 2 standard deviations above average minimum requirements in order to take into account 97.5% of individuals (FAO/WHO/UNU 1985, 1988). As such, these figures provide a very conservative indication of the risk of dietary inadequacy.

Table 5.5 Seasonal Variation in Nutrient Intake per Consumption Unit in Sèbèkoro: n=33 households				
	mean daily nutrient intake by season (sd)			
nutrient	harvest	dry	rainy	I
energy (kcals)	2795 (428)	2471 (391)	2734 (443)	**
digestible protein (g)[a]	78.6 (14.4)	65.3 (15.9)	69.0 (19.2)	****
fat (g)	58.5 (12.2)	44.0 (13.1)	52.9 (17.9)	****
carbohydrate (g)	507.9 (88.6)	483.9 (77.6)	505.5 (82.4)	N/S
calcium (mg)	756.6 (347.0)	738.8 (407.3)	613.3 (248.0)	*
iron (mg)	78.4 (57.1)	109.2 (58.0)	112.7 (56.0)	**
thiamine (mg)	2.2 (0.4)	1.8 (0.3)	1.9 (0.5)	****
riboflavin (mg)	1.0 (0.2)	1.0 (0.3)	1.0 (0.3)	N/S
niacin (mg)	31.5 (5.3)	23.7 (7.1)	25.3 (8.7)	****
vit C (mg)	29.7 (34.0)	52.5 (45.8)	13.1 (9.8)	****
vit A (µg RE)[b]	375 (351)	658 (421)	294 (243)	**
food received (kcal)	79 (155)	51 (100)	74 (148)	N/S
food given (kcal)	79 (141)	95 (167)	35 (71)	N/S

I Repeated measures analysis of variance: N/S not significant * $p<0.05$ ** $p<0.01$ *** $p<0.001$ *** $p<0.0001$
[a] corrected for the digestibility of a high fibre diet: (g protein * 0.85)
[b] RE or Retinol Equivalents: 1RE= 1µg retinol or 6µg beta carotene

In Table 5.5, significant seasonal variation in iron intake is observed ($p<0.01$). However, in every season iron intake per consumption unit exceeds the most elevated FAO/WHO Expert Consultation (1988) requirements to prevent anaemia in menstruating women consuming a low bio-availability diet (48 mg)[6]. However, impaired absorption due to the presence of phytate in cereals (which supply 88-91% of iron intake) may also be exacerbated by seasonal deficiencies of vitamin C which acts as a reducing agent to convert ferric iron to its ferrous, absorptive form[7].

With respect to water soluble B-vitamins, significant seasonal variations are apparent for both thiamin ($f=14.85$ $p<0.0001$) and niacin ($f=21.90$ $p<0.0001$). Univariate analysis of variance indicates that harvest season intakes are significantly higher than dry season intakes in both cases (thiamin $f=29.59$ $p<0.0001$; niacin $f=22.70$ $p<0.0001$). Ranging from 0.69 to 0.79 mg/1000 kcal, thiamin exceeds the safe level of intake of 0.55 mg/1000 kcal in every season, while niacin (9.3 to 11.3 niacin equivalents/1000 kcal) is also well above the 6.6 niacin equivalents/1000 kcal recommended by FAO/WHO (1967).

No seasonal variations are noted for Riboflavin, nor do seasonal intakes meet the safe level of 0.55 mg/1000 kcal proposed by FAO/WHO (1967). Varying from 0.34 mg/1000 kcal to 0.41 mg/1000 kcal in a manner typical of a cereal-based diet lacking in egg and dairy products, the intake of 81%-100% of households falls below the recommended safe level depending on the season. The literature is still unclear about the impact of riboflavin deficiency on health and function. A study by Thurnham et al. (1983) in Papua New Guinea reveals higher malarial parasite densities in riboflavin deficient children, while data from India (Das et al. 1988) suggest that riboflavin deficiency simultaneously inhibits the growth and multiplication of malarial plasmodia, and slows disease recovery time.

Highly significant seasonal variations are apparent for vitamin C mainly due to the seasonal availability of fruits and vegetables. From a mean intake of 29.7 mg in the harvest season

---

[6]Contrary to this finding are studies indicating a high prevalence of anaemia is in the Malian population particularly among pregnant women (Benefice et al. 1981, Mondot-Bernard and Labonne 1982). However, in addition to low iron intake, anaemia may also be provoked by hereditary defects such as the sickle cell trait; by the loss of haemoglobin due to haemorrhaging associated with parasitic disease such as hook-worm and schistosomiasis; or by B12 and/or folate deficiencies which interfere with the production of erythrocytes.

[7]Phytic acid is known to bind iron and calcium into insoluble complexes, however, it is not clear to what degree it reduces the availability of minerals in the diet (Passmore and Eastwood 1986:117).

when vegetables and wild fruits are relatively abundant, vitamin C intake rises to 52.5 mg as mangos ripen in the dry season, then falls to 13.1 mg in the rainy season. With respect to FAO/WHO Expert Group recommendations (1970) of a safe level of intake of 30 mg, 70% of households are at some risk of deficiency in the harvest season, compared to 45% in the dry season, and 94% in the rainy season[8]. However, given the absence of obvious acute deficiency symptoms (tissue degeneration, haemorrhaging, etc.), it may be that tissue stores of Vitamin C in the brain and liver acquired in the harvest and dry seasons are substantial enough to supplement insufficient intake in the rainy period (Passmore and Eastwood 1986:147).

Seasonal variations in vitamin A intake are also quite marked ($f=8.02$ $p<0.01$). The majority of vitamin A in Bamana diet derives from the carotenoid ß-carotene found in yellow fruits and green leafy vegetables. Due to the inefficiency of absorption and conversion of ß-carotene to retinol, translation into Retinol Equivalents (RE) provides a better measure of vitamin A activity[9]. With the ripening of mangos rich in ß-carotene in the dry season, mean vitamin A intake (658 RE µg) exceeds a safe level of intake of 500-600 RE µg for adults (FAO/WHO 1988). Given that children are the primary consumers of mangos, the probability of inadequate intake in this group is extremely low. However, mean vitamin A intake in the harvest (375 RE µg) and rainy (294 RE µg) seasons fall below the safe level. Compared to the rainy season when 24% of households fall below basal requirements of 300-350 RE µg, 51% and 70% of households may be considered at risk of deficiency in the harvest and rainy seasons respectively[10].

In addition to Xerophthalmia, there is evidence in the literature of an association between vitamin A deficiency and disturbances in cellular immunity, lysozyme activity, and increased

[8]Mondot-Bernard and Labonne (1982) found low vitamin C intakes in all eight villages surveyed in rural areas of Mali (1st, 3rd, 5th, 6th and 7th regions), but adequate intakes in urban survey sites in Bamako and Segu.

[9]Taking into account the bioavailability of ß-carotene and the efficiency of its conversion to retinol, the net biological activity of 6µg of ß-carotene is made equivalent to 1µg of retinol.

[10]As defined by FAO/WHO (1988), the 'basal requirement' of an individual is the minimum daily intake of vitamin A needed to prevent clinical signs of deficiency (night blindness and epithelial lesions of the conjunctiva and cornea of the eye), and to permit normal growth.

risk of morbidity and mortality (Mohanram et al. 1974, Sommer et al. 1984, Gopalan 1986, West et. al 1989). However, it is difficult to speculate on the impact of transitory deficiency in the study population given the large liver stores of vitamin A in the form of retinyl esters which may be hydrolysed to release retinol when needed (FAO/WHO 1988:16).

With respect to the hypothesis that seasonal variation in energy balance is a response to constrained energy intake in the rainy season, results suggest that household food consumption is not a primary determinant of nutritional risk in year of study. Not only is energy intake in the rainy season maintained (or increased) relative to other seasons, for the most part seasonal diet appears to fulfil safe levels of most nutrients with the exception of rainy season deficiencies of riboflavin, and vitamins A and C. Indeed, in the absence of manifest deficiency symptoms, it could be speculated that the body has developed very effective storage mechanisms which act to smooth out seasonal peaks and troughs of supply for even these nutrients. Unfortunately, the method of measurement does not permit an assessment of the distribution of seasonal intake among age and gender groups within the household, nor does it provide a notion of interannual variation in intake. By most accounts, the soudure season in question was relatively mild, and results should be interpreted accordingly.

5.2 Seasonal Energy Expenditure of Active Adults

The second hypothesis proposes that negative energy balance in the rainy season is more a reflection of increased energy expenditure due to the intensity of agricultural activity, than a problem of constrained intake. To explore this hypothesis, seasonal activity patterns and energy expenditure are investigated by means of timed observations made on a random sample of active adults over a 15 hour waking day[11].

[11]See Chapter II for a description of time allocation methods, and Appendix III for the energy cost per activity values used to convert timed observations into estimates of energy expenditure.

a) Seasonal Time Allocation

Tables 5.6 and 5.7 present the seasonal time allocation of male and female adults in terms of eight functional categories of activity: resting, social, general, manufacture and crafts, gathering, agricultural, food preparation and household. The computed duration of each category of activity does not include rest periods within that activity. Rather, these are coded under the appropriate 'resting' category.

Comparison of male and female activity patterns reveals a very distinct gender division of labour. During the waking day, women spent 26% less time 'resting' (2 h 07) than the male sample (3 h 33). This disparity is very marked in the harvest season when men spend 4 hours in each waking day engaged in 'resting' activities such as lying, dozing, sitting, and standing inactive compared with 2 hours and 46 minutes for women.

On average, men devote 40% more time to social activities than women particularly during the dry season when marriage and initiation ceremonies take place (men 2 h 43; women 1 h 37). In terms of overall productive activity, men allocate 28% of the waking day to agriculture, 6% to crafts and manufacture such as basket and rope-making, 3% to hunting and gathering bush produce, and 8% to household activities, most notably, household construction and repair. Male agricultural activity is very seasonal in character occupying almost 7 hours of the waking day during the rainy season compared to an average of 2.5 to 3 hours in the dry and harvest seasons (Table 5.6).

Women allocate 64% less time to agriculture than the male sample. Most of this time is devoted to the household field (*forobaforo*) and the female tasks of weeding and winnowing the harvested crop, although in a few cases, female subjects were observed working in personal fields (*jònforow*). Occupying a negligible percentage of female time, gathering activities are mainly focused on the collection of shea-nut fruit in the rainy season, while 4% of the waking day is devoted to female crafts such as spinning cotton, and the manufacture of soumbala and shea-nut butter for sale and household consumption (Table 5.7).

Table 5.6 Seasonal Time Allocation of Active Males in Sèbèkoro by Category of Activity

	mean hr min	% of 15 hr waking day mean %	n=12 harvest	n=12 dry	n=12 rainy
resting	3 h 33	24	27	27	17
social	2 h 43	18	19	21	15
general	1 h 50	12	13	11	12
manu/crafts	56	6	9	6	4
gathering	28	3	--	7	3
agricultural	4 h 11	28	20	17	47
food prep	6	1	1	--	--
household	1 h 13	8	11	11	2

Table 5.7 Seasonal Time Allocation of Active Females in Sèbèkoro by Category of Activity

	mean hr min	% of 15 hr waking day mean %	n=12 harvest	n=12 dry	n=12 rainy
resting	2 h 37	17	19	19	15
social	1 h 37	11	7	13	13
general	2 h 49	19	19	20	17
manu/crafts	36	4	5	2	4
gathering	3	10	--	--	1
agricultural	1 h 30	18	14	1	15
food prep	2 h 43	21	16	23	15
household	3 h 05	13	20	22.	20

Women spend comparatively more time engaged in 'general' activities such as child care, personal hygiene and walking, and other domestic duties including 'food preparation' and 'household' chores. On average, 2 hours and 43 minutes are devoted to 'food preparation' which involves both cereal processing and meal preparation. Over three hours are spent doing various 'household' chores such as washing clothes and dishes, sweeping, fuel and water gathering. Combined, these general and domestic activities comprise 8 hours and 37 minutes of the female working day compared to only 3 hours for men. With the exception of an increase in time devoted to 'food preparation' in the dry season when celebratory feasts occur, little seasonal variation is evident in female time allocation.

In sum, the male sample is engaged in non-resting/non-social activities for 58% of the waking day compared to 72% for women. Furthermore, when time allocation patterns are assessed seasonally, greater variation is apparent in male activity. While non-resting non-social activity account for 46% of the waking day in the harvest and dry seasons, this increases to 68% when agricultural work intensifies. Little seasonal variation is apparent for women with non-resting/non-social activity accounting for 75% of the waking day in the harvest season, and 68% and 72% in the dry and rainy seasons respectively.

b) Seasonal Energy Expenditure

Reflecting the seasonal energy patterns described in the previous section, Figure 5.2 illustrates monthly fluctuations in energy expenditure for the sample of active adults in Sèbèkoro, while Figure 5.3 aggregates monthly measurements into seasonal averages for both sexes.

Figure 5.2 Male and Female Energy Expenditure by Month

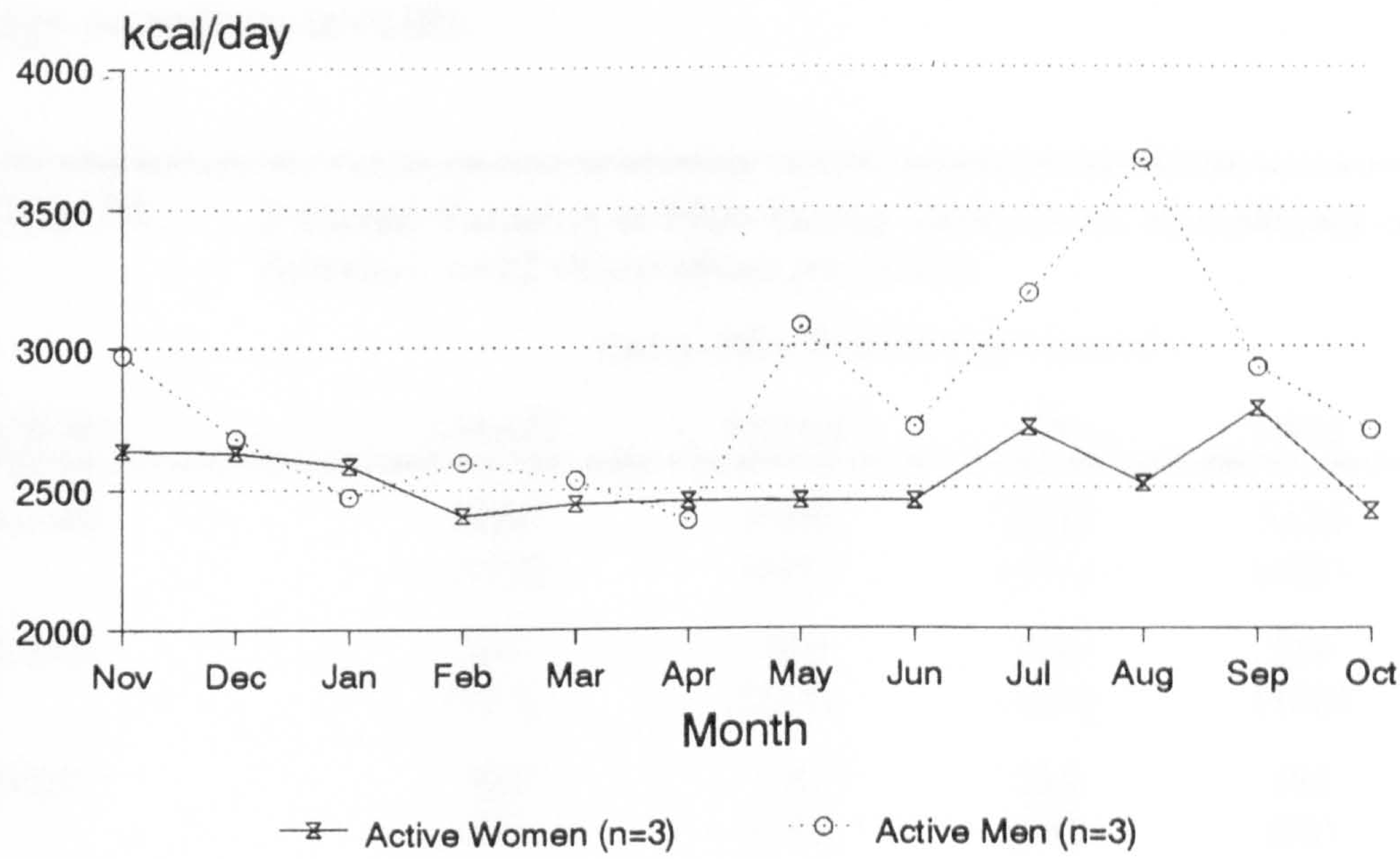
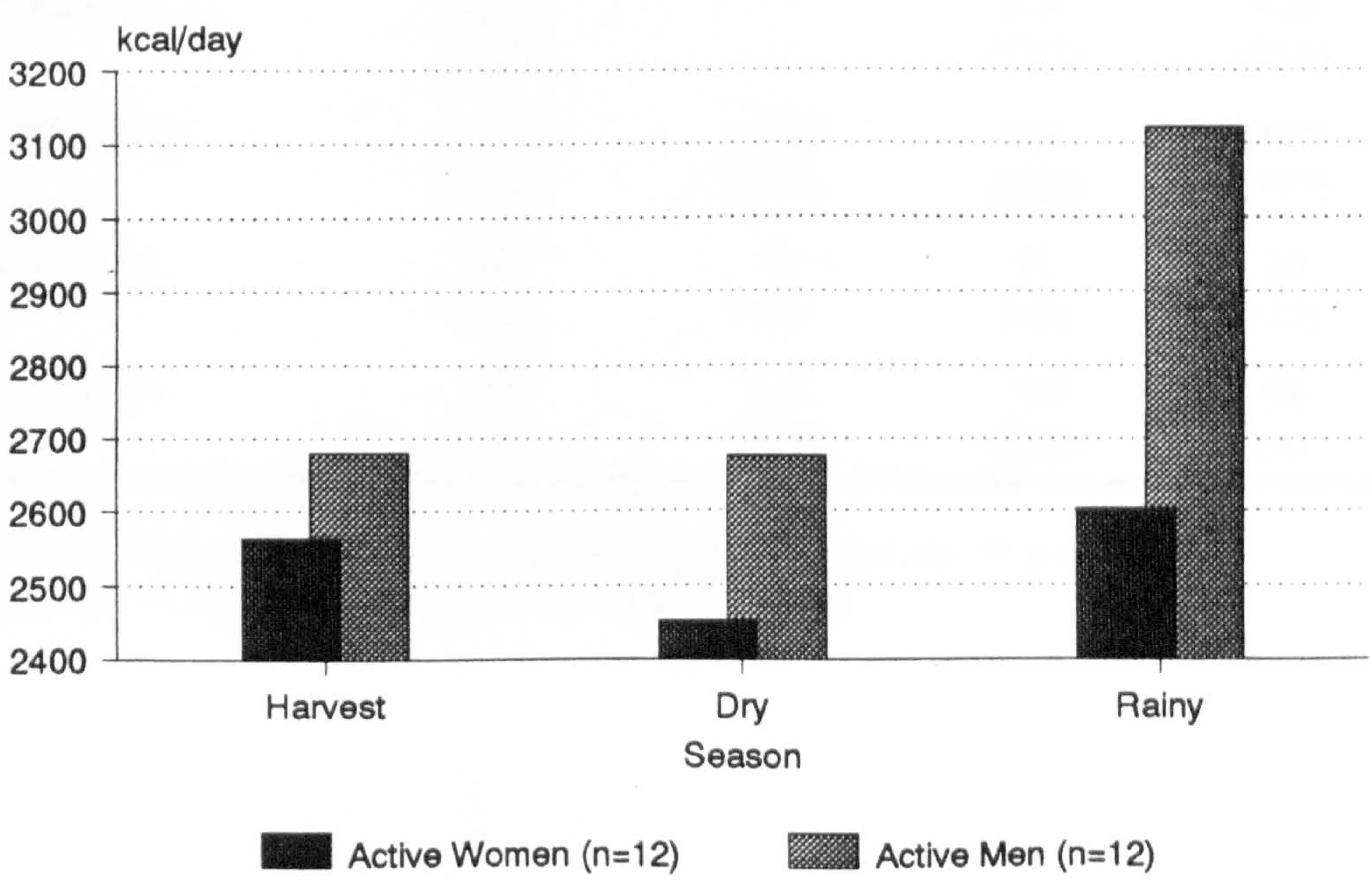


Figure 5.3 Male and Female Energy Expenditure by Season



Sebekoro, Mali

As summarized in Table 5.8, significant seasonal variation in male energy expenditure is revealed using one-way analysis of variance (f=4.19 p<0.05). Expressed in terms of a standard body weight of 60 kg, male energy expenditure is constant in harvest and dry seasons (2680 and 2676 kcal respectively), rising to 3122 kcal as agricultural activity intensifies in the rainy season. As Table 5.8 indicates, concomitant with a significant increase in agriculture-related energy expenditure in the rainy season (p<0.01) is a significant decrease in 'resting' energy expenditure (p<0.05).

Table 5.8 Seasonal Variation in Male Energy Expenditure by Category of Activity: n=12 observations per season

	mean daily kcal(sd) by season[a]				
activity	overall	harvest	dry	rainy	I
overall	2826 (472)	2680 (409)	2676 (414)	3122 (475)	*
resting	295 (135)	320 (153)	320 (123)	219 (100)	*
social	300 (87)	330 (78)	284 (94)	285 (88)	N/S
general	241 (144)	256 (159)	278 (156)	188 (109)	N/S
manu/crafts	206 (253)	323 (220)	134 (267)	190 (256)	N/S
gathering	395 (395)	7 --	455 (537)	426 (710)	N/S
agricultural	1039 (822)	802 (617)	607 (635)	1665 (795)	**
food prep	38 (36)	64 (43)	21 (18)	20 (22)	N/S
household	331 (444)	464 (530)	399 (482)	98 (141)	N/S

I One-way analysis of variance: N/S not significant * p<0.05 ** p<0.01

[a] expressed in terms of a standard body weight of 60 kgs

The lack of significant seasonal variation in female energy expenditure reflects the unvarying nature of women's work in Bamana society. Expressed in terms of a standard body weight of 55 kg, female energy expenditure decreases slightly from 2564 kcal in the harvest season, to 2453 kcal in the dry season, before rising to 2603 kcal with the commencement of the agricultural season. When seasonal energy expenditure is analyzed according to category of activity, agricultural activity is the only category where significant seasonal variation is observed (Table 5.9).

Table 5.9 Seasonal Variation in Female Energy Expenditure by Category of Activity: n=12 observations per season

activity	overall	harvest	dry	rainy	I
	mean daily kcal(sd) by season[a]				
overall	2540 (224)	2564 (259)	2453 (160)	2603 (233)	N/S
resting	203 (87)	214 (82)	222 (95)	173 (83)	N/S
social	378 (115)	400 (93)	395 (133)	339 (114)	N/S
general	137 (87)	90 (57)	160 (75)	158 (108)	N/S
manu/crafts	152 (201)	121 (92)	75 (69)	274 (341)	N/S
gathering	10 (31)	19 (24)	-- --	31 (31)	N/S
agricultural	349 (381)	432 (452)	59 (46)	507 (357)	*
food prep	438 (280)	403 (263)	542 (227)	368 (331)	N/S
household	528 (248)	528 (317)	555 (218)	501 (215)	N/S

I One-way analysis of variance: N/S not significant * $p<0.05$
[a] expressed in terms of a standard body weight of 55 kgs

Expressed as a multiple of BMR, male energy expenditure values represent 'light' activity in the harvest (1.71*BMR) and dry seasons (1.67*BMR), and 'moderate' to 'heavy' expenditure in the rainy season (1.92*BMR). Female energy expenditure values correspond with a 'moderate' degree of activity in the harvest season (1.79*BMR), and to 'heavy' activity in both dry (1.82*BMR) and rainy (1.94*BMR) seasons (FAO/WHO/UNU 1985:78)[12].

While results correspond reasonably closely to studies of energy expenditure conducted in similar populations and ecological zones, less dramatic seasonal variation is apparent in both male and female samples. From field measurements of O_2 consumption, Fox (1953) estimates a male energy expenditure of 3438 kcal for Gambian farmers during the agricultural season. In a study of Mossi agriculturalists, Brun et al. (1981) arrive at a mean energy output of 2410 kcal in the dry season, and 3460 kcal in the rainy season using a similar combination of indirect calorimetry and activity monitoring. In the latter case, rainy season measurements were conducted during the most energy intensive month of the agricultural season which may account for the high recorded expenditures relative to the present study.

Figures most resembling the study results are obtained if the energy cost values calculated by Brun et al. (1981) are applied to monthly time allocation data on male Mossi farmers collected by Ancey (1974) over a year-long period. Mean energy expenditure varies from 2420-2590 kcal in the harvest and dry seasons, and averages 3173 kcal in the rainy season.

When female energy expenditure patterns are compared with data from similar dryland farming populations in West Africa, differences in the magnitude of seasonal variation are particularly striking. In a study of child-bearing Gambian women, Lawrence and Whitehead (1988) measure a total energy expenditure ranging from a minimum of 2300 kcal (1.7*BMR) in the harvest and dry seasons, to a maximum of 2700 kcal (2.0*BMR) during the agricultural season. Expressing the energy expenditure of Mossi women farmers in terms of a standard weight of 55 kgs, Bleiberg (1980) calculate a mean daily expenditure of 2320 kcal in the dry season and 2890 kcal in the rainy season. When the energy cost values of Bleiberg et al. (1980) are applied to time allocation data collected by Ancey (1974), mean expenditure

[12]Recent studies suggest the BMR may be overestimated using FAO/WHO/UNU prediction equations by a factor of about 8% (Henry and Rees 1991). Applying this to the figures above, seasonal multiples of BMR will be 8% greater, such that male activity would become 'moderate' in the harvest and dry seasons, and 'heavy' in the rainy season, while female activity would be 'heavy' in every season.

figures are derived which range from 2180-2430 kcal in the harvest and dry seasons to an average of 2900 kcal in the rainy season.

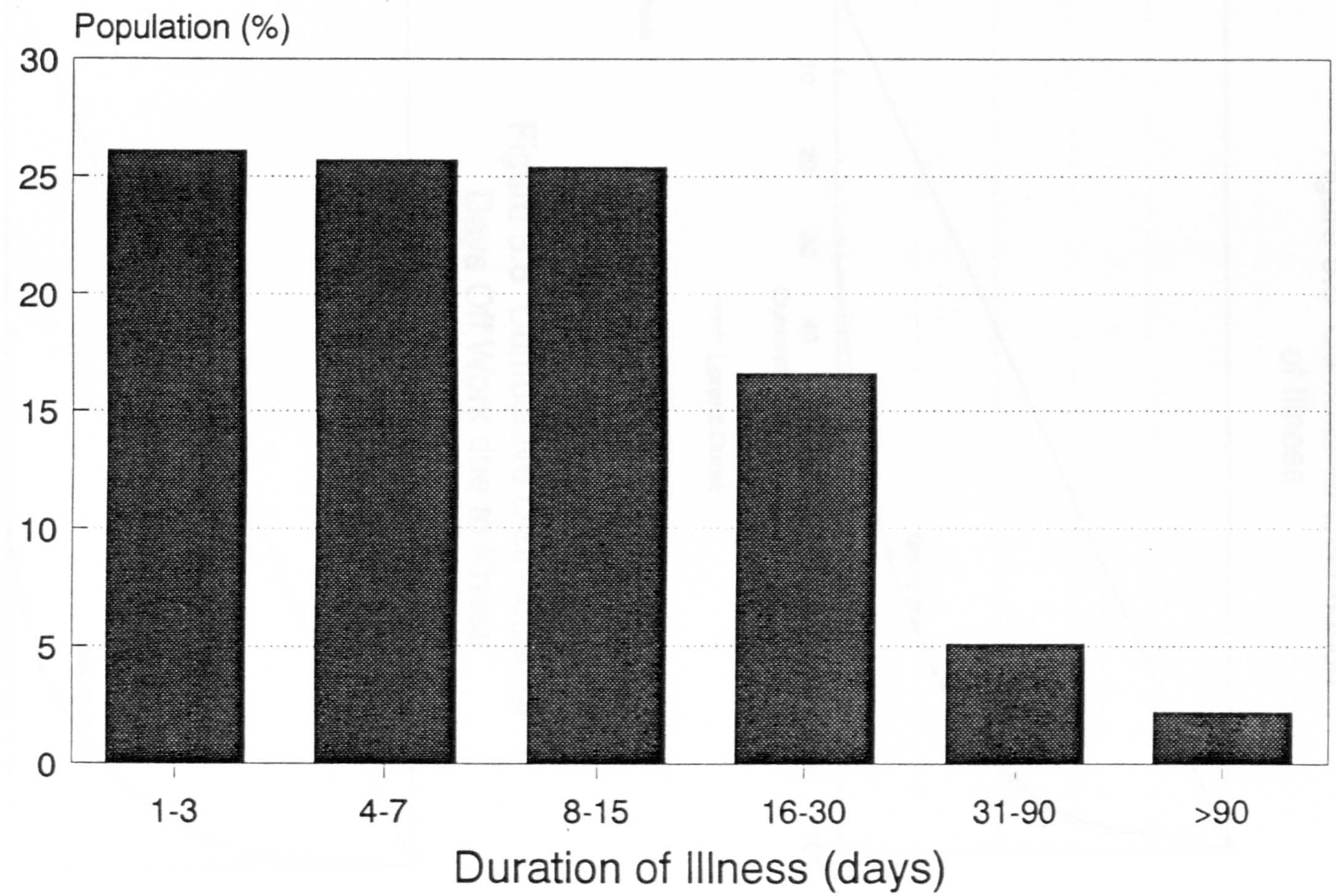
Relative to these studies, the energy expenditure patterns of women in Sèbèkoro show less seasonal variability. Easing to 'moderate' levels of activity in the harvest season, the female sample has little apparent opportunity to recover from the 'heavy' levels of expenditure experienced in successive dry and rainy seasons. While more dramatic seasonal variability is evident in male sample, periods of 'light' activity in both harvest and dry seasons provide them with a reasonably lengthy time in which to reconstitute their fitness after the physical demands of the agricultural season. On the whole, patterns of energy expenditure in active adults correspond very closely with seasonal variations in anthropometric indicators of nutritional status; the loss of body fat coinciding with the onset of heavy agricultural work, and its recovery with the conclusion of the agricultural season.

5.3 Seasonal Morbidity

The third hypothesis to be investigated speculates that fluctuations in energy balance are a consequence of seasonal morbidity and its effects on activity, appetite and absorption. In this section, retrospective data on morbidity episodes over an annual cycle are used to explore the seasonal character of morbidity, and its differential impact on age/gender groups and work-related activity.

Over the study year, 70.5% of the population report a morbidity episode, the majority of which last 15 days or less (Figure 5.4). The highly skewed nature of the cumulative distribution of morbidity in Sèbèkoro is illustrated by the Lorenz Curve presented in Figure 5.5. A Gini Coefficient of 0.70 implies that 10% of the village population account for 57% of morbidity days reported. A similar skewed distribution is observed among individuals who missed work due to illness (Figure 5.6): 10% of those who were ill account for 72% of days-off-work (Gini=0.80).

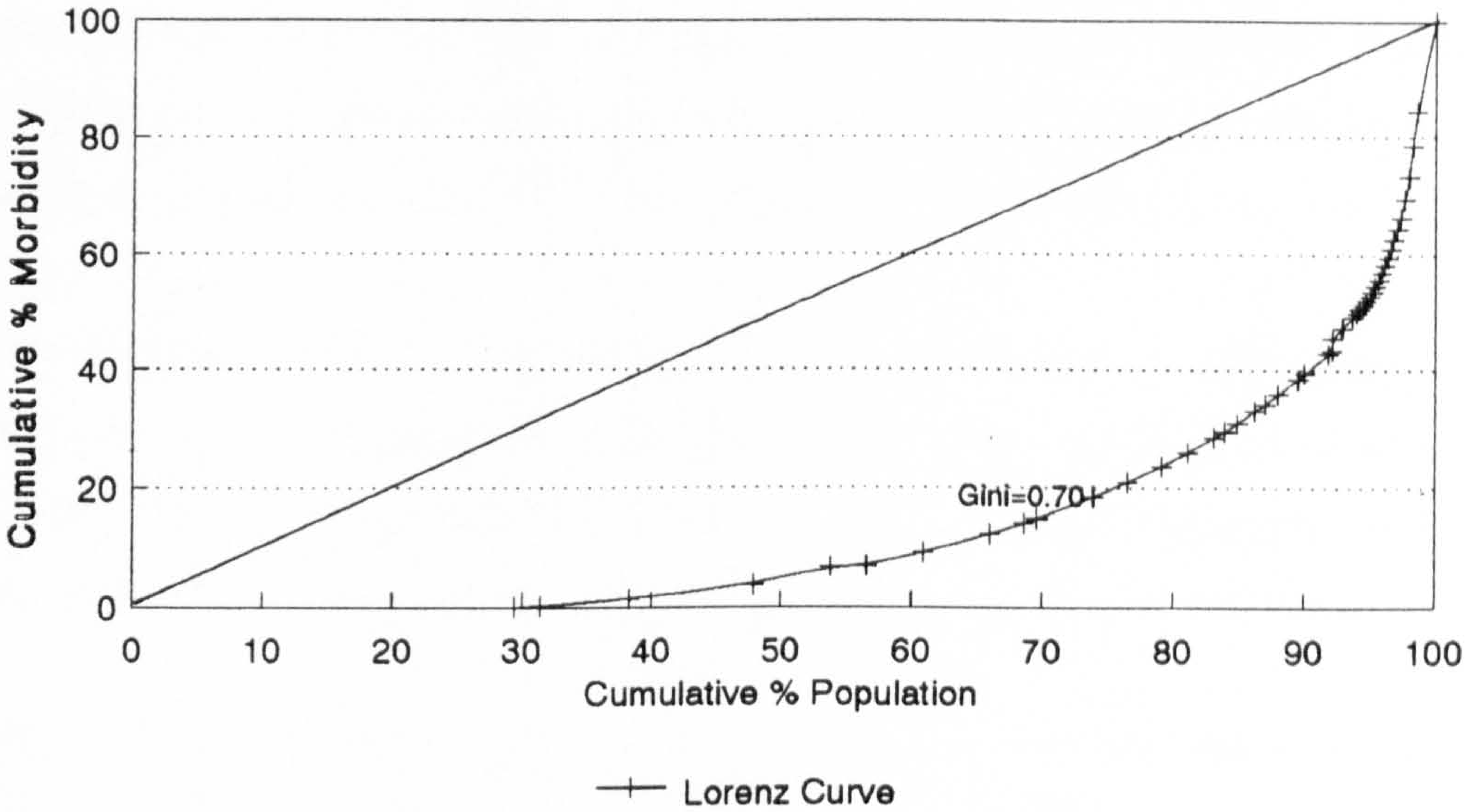
Figure 5.4 Duration of Morbidity Episodes



n=391 individuals

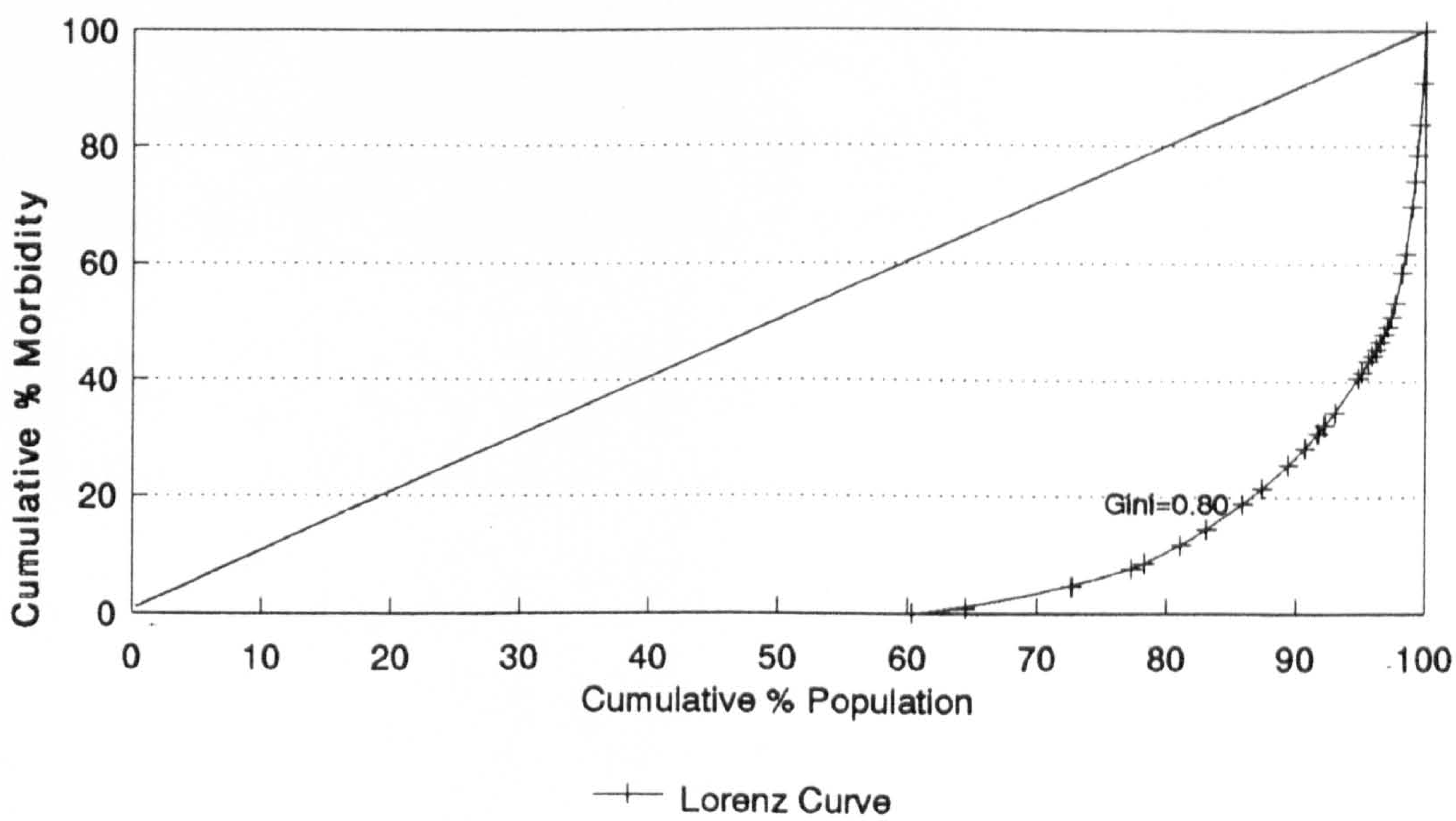
Sebekoro, Mali

Figure 5.5 Cumulative Distribution of Illness



n=391 individuals

Figure 5.6 Cumulative Distribution of Days Off Work due to Illness



n=391 individuals

Sebekoro, Mali

A strong positive correlation between age and duration of illness suggests that with increasing age, individuals are more likely to be ill for longer periods of time ($r=0.61$ $p<0.001$). This is confirmed by one-way analysis of variance which detects significant age group differences in the duration of morbidity in dry ($f=2.80$ $p<0.05$) and harvest seasons ($f=3.21$ $p<0.05$).

Repeated measures analysis of variance also indicates a significant age group effect on seasonal variation in morbidity duration ($f=2.25$ $p<0.05$). However, neither Scheffe's procedure nor univariate f-tests between individual contrasts is successful in locating significant differences at the 0.05 level between particular seasons.

Further analysis reveals striking seasonal variation in morbidity in terms of its symptomology, incidence, and its consequent impact on productive activity. Table 5.10 presents the seasonal frequency of morbidity episodes classified into 6 broad categories: fever, diarrhoeal, respiratory, acute injury, chronic pain and other symptoms[13].

Table 5.10 Seasonal Frequency of Morbidity Episodes in Sèbèkoro

symptoms	overall n=634	%	harvest n=107	%	dry n=84	%	rainy n=443	%
fever	282	44	52	48	21	25	209	47
diarrhoeal	78	12	7	7	19	23	52	12
respiratory	105	17	5	5	11	13	89	20
acute injury	76	12	15	14	14	16	47	11
chronic pain	25	4	5	5	4	5	16	3
other	68	11	23	21	15	18	30	7

Fever is the most common symptom recorded in every season. After fever, 'other' complaints (pregnancy, circumcision etc.) and acute injuries are most common in the harvest season.

[13]Symtoms included in the category 'respiratory' include sore throat, head and chest ache, cough and head cold. 'Fever' symptoms are usually associated with malaria, while rheumatism, back and general aches and pain are grouped under the category 'chronic pain'. 'Acute injuries' include infections, burns, abrasions, dog and snake bites, and work-related trauma.

Diarrhoeal episodes and other complaints represent the second and third most frequent morbidity in the dry season, while in the rainy season, respiratory, diarrhoeal and acute injury episodes follow fever in order of incidence. Overall, the frequency of morbidity episodes in the rainy season is 4-5 times greater than harvest or dry seasons, accounting for 70% of total morbidity episodes.

Comparing the seasonal incidence of morbidity symptoms for particular age groups in the population, the under five-group, which represents 21% of the population, experiences 28% of morbidity episodes while the 5-15 age group, which constitutes 33% of the village population, experiences 32% of morbidity episodes. The adult population (46% of total) accounts for the remaining 46% of reported morbidity. Figure 5.7 contrasts the annual prevalence of morbidity symptoms by age group. When morbidity is analyzed seasonally, the under-five age group accounts for an elevated 36% of fever symptoms, and 31% of respiratory symptoms in the rainy season. If the 5-15 age group is also included, children under 16 years of age (54% of the population) experience 78% of rainy season fever symptoms, and 69% of respiratory symptoms. By contrast, adults account for 60% of diarrhoeal symptoms, 57% of acute injury symptoms and 94% of chronic pain complaints.

Of particular note is the high incidence of predominantly malaria-related fever episodes among children in the rainy season. Not only has malaria been shown to impair growth and immune function, Brown et al. (1985) note a 10% decrease in the intake of most nutrients during febrile episodes. Both Hoyle et al. (1980) and Tomkins (1983) have observed similar decreases in energy intake among children with diarrhoea compared to healthy controls. Faecal losses, impaired absorption, the energy cost of fever, and the Bamana tendency to tolerate anorexia associated with illness may jeopardize further the nutritional status of sick children.

As regards the impact of elevated rainy season morbidity on productive work, 6-7% of the active population lost work due to illness in the harvest and dry seasons compared to 30% during the rainy season.

Figure 5.7 Morbidity Symptoms by Age

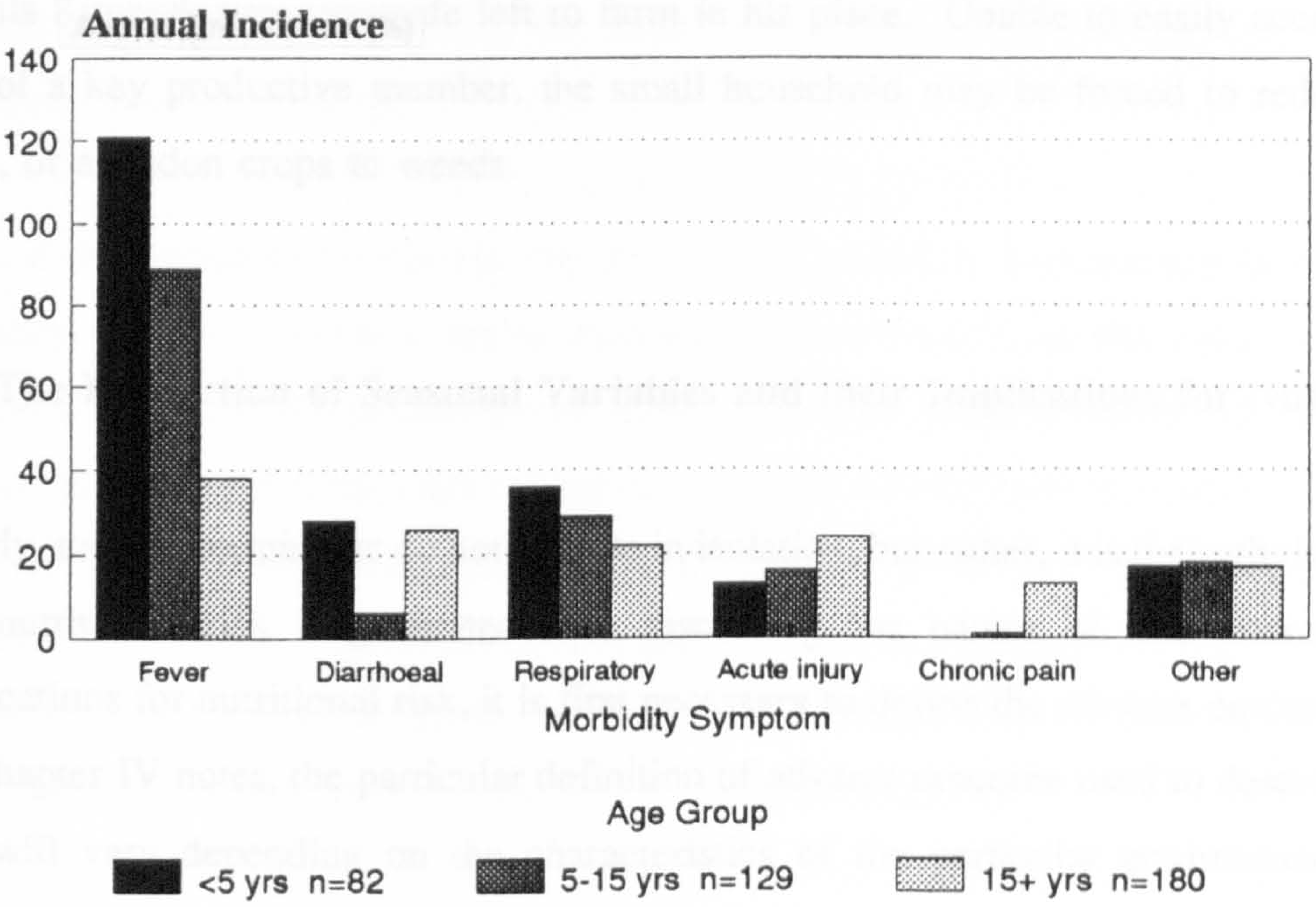
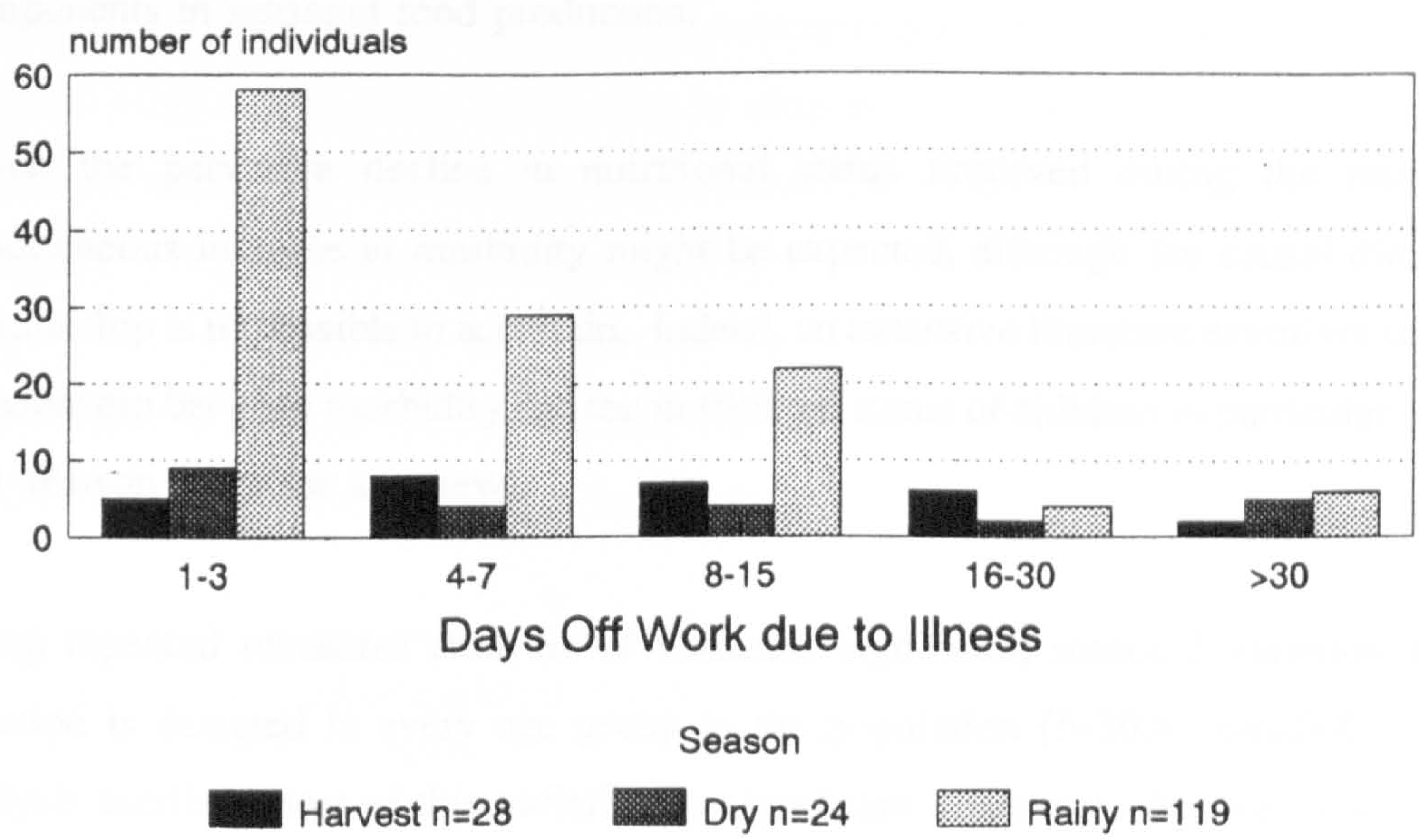


Figure 5.8 Days Off Work due to Illness by Season



n=391 individuals

Sebekoro, Mali

As Figure 5.8 illustrates, this dramatic increase in morbidity preventing work in the rainy season is mostly acute illness episodes less than 15 days in duration. Clearly, the risk of adverse productive consequences is far greater in small households, particularly when morbidity coincides with the critical agricultural periods of seeding and weeding. Such was the case in household #221 when the only adult male was taken ill during the weeding period, and his 8 month pregnant wife left to farm in his place. Unable to easily accommodate the loss of a key productive member, the small household may be forced to reduce cultivated areas, or abandon crops to weeds.

5.4 The Interaction of Seasonal Variables and their Implications for Nutritional Risk

Clearly, these determinants do not operate in isolation, but rather, it is through their interaction that nutritional risk is generated. In discussing the nature of this interaction and its implications for nutritional risk, it is first necessary to define the adverse outcome of interest. As Chapter IV notes, the particular definition of adverse outcome used to describe nutritional risk will vary depending on the characteristics of the particular environment concerned, resource availability, nutritional paradigm, and purpose. The following analysis considers seasonal nutritional risk in terms of the adverse outcome 'morbidity', and comments more generally on its possible consequences for 'work capacity'. Both outcome variables are particularly pertinent to subsistence agriculture where physical fitness and health are critical components in seasonal food production.

Given the pervasive decline in nutritional status observed during the rainy season, a simultaneous increase in morbidity might be expected, although the causal direction of this relationship is impossible to accertain. Indeed, an extensive literature examines the synergistic relationship between morbidity and the nutritional status of children in particular (see Tomkins and Watson 1989 for a review).

Using repeated measures analysis of variance, significant seasonal variation in morbidity duration is detected in every age group in the population ($f=30.81$ $p<0.0001$). Univariate analysis ascribes most of this variation to significant differences between a shorter duration of morbidity in the dry and harvest seasons, and a longer duration in the rainy season ($f=7.30$

of morbidity in the dry and harvest seasons, and a longer duration in the rainy season (f=7.30 <0.01). Although this increase in morbidity coincides with a general decrease in the nutritional status in the rainy season, significant correlations between rainy season nutritional status and morbidity duration are confined to children under-five years of age (w/h and duration: $r=-0.29$ $p<0.01$). Although an overall negative correlation between BMI and morbidity duration is apparent in the adult female population ($r=-0.35$ $p<0.01$), no rainy season correlation is evident[14].

While it is impossible to discern the direction of causality between nutritional status and morbidity, results suggest a strong environmental influence in the etiology of seasonal nutritional risk among children under five. However, given the lack of synchronism in seasonal growth rates among age cohorts in the under five population, it is clear that a myriad of nutritional, socio-cultural, physiological as well as environmental determinants are operating. Hence, while child nutritional status may reflect overall environmental economic, and socio-cultural deprivation, it may be unwise to consider seasonal variations in child nutritional status a reliable indicator of household food supply[15].

Like the association between nutritional status and morbidity, that between nutritional status and physical work capacity is equally complex (see Ferro-Luzzi 1985 for a review). A number of studies have found that decreased energy intake and low lean body mass compromise physical work capacity and the productivity of agricultural labour (Spurr 1984, Immink et al. 1984). Contrariwise, work productivity has been found to have no correlation with low food consumption among female chapatti producers (Sukhatme 1982), nor has it been found to improve with the supplementation of 'inadequately' nourished Gambian farmers during the 'hungry season' (Diaz et. al. 1991).

As described in Chapter IV, a significant decrease in BMI and % body fat occurs in the rainy season among the adult population in Sèbèkoro. Results from this chapter suggest that the

[14]This finding further confirms the chronic nature of female nutritional risk particularly in the post-reproductive years.

[15]Given evidence of significant seasonal growth in western populations, it is has been argued that growth disturbances in the developing world may well be due to factors other than food insufficiency or disease (Payne 1990).

initial stimulus to body weight loss in the rainy season is most probably the onset of heavy agricultural work, and not a decline in food intake *per se*. As energy output exceeds intake, a significant mobilization of energy from body fat occurs in response to a state of negative energy balance. The apparent conservation of lean tissue, or muscle mass, suggests that the observed seasonal change in nutritional status is unlikely to compromise physical work capacity or productivity[16].

It may be argued, however, that physical work capacity is not simply a function of current conditions such as food availability, but is also dependent on long-term nutritional status. This longer-term view suggests that inadequate nutrition during the growth and development years of childhood (particularly under-fives), leads to delayed maturation, and a failure to achieve normal adult weight (Satanarayana 1985, Eveleth 1985).

Interpretation of these observations is contingent on whether one considers them to be the unacceptable consequence of environmental insult, or the acceptable product of genetic adaptation. On the one hand, low body weight is considered a nutritional deficit and a constraining factor to optimal physical work capacity and work-productivity (Spurr 1984, Immink et. al. 1984). On the other, is the viewpoint that (within limits), body size has adapted to function optimally in this subsistence environment (Dugdale and Payne 1977, Sukhathme 1984, Seckler 1982). Supporting this adaptation viewpoint are the findings of Mingelli et al. (1990) which indicate that relative to a matched European sample, Gambian subsistence agriculturalists have a lower basal and sleeping energy expenditure, a reduced dietary induced thermogenesis, and higher work efficiency. In the context of the present study, it is reasonable to question the influence of a modest seasonal loss of adipose tissue on work capacity and functional competence. Indeed, in support of the hypothesis on adaptation it may be argued that this loss represents a successful biological strategy in a season of relative scarcity: whereby a lower body weight is assumed which requires less food energy to maintain (Dugdale and Payne 1977).

[16] Perhaps in more severe soudure conditions, both energy availability and lean body mass could act as more important determinants of physical work capacity.

CHAPTER VI: SEASONAL FOOD INSECURITY AND THE HOUSEHOLD

6.0 Introduction

Focusing on nutritional risk at the level of established age and gender groups in the study population, Chapter V alluded to some of the complex interactions between physiological, economic, social and environmental risk factors. It considered the fluctuating nutritional status of age and gender groups in terms of the seasonal exertion associated with subsistence agricultural production, the physical demands of socially defined age and gender group roles, and the environmental constraints of seasonal morbidity and food availability. This chapter addresses the larger socio-economic and environmental context of nutritional risk. It extends the perception of risk from the orthodox focus on vulnerable groups to the household level where many adverse risk factors merge and influence the nutritional status of individual household members. In focusing on the household as a unit of analysis, the concept of nutritional risk must therefore be broadened to incorporate the larger system in which food is produced, distributed, and consumed.

Accordingly, in this chapter, **household nutritional risk** is defined as the potential for a situation of 'food insecurity' to occur at the household level, rather than the physiological manifestation of inadequate intake in particular age and/or gender groups (McLean 1984:16). **Household food insecurity** denotes a lack of *secure* access to an *adequate* and *viable* supply of food needed to support the health and activity of household members[1]. Of course, both individual and household-based concepts of nutritional risk are inter-related: hunger and malnutrition compromise the ability of the household labour force to sustain a viable household food system, while conditions of poverty and food insecurity at the household level compromise the nutritional status of individual household members.

This chapter explores the hypothesis that exogenous factors (poor rainfall, high cereal prices, unfavourable bio-geographic location), and endogenous household characteristics (poverty,

[1]'Secure access' refers to the need for a readily available and sustainable food supply, 'adequate' implies that the food supply be both culturally acceptable and sufficient to meet the nutritional needs of individual household members, while the term 'viable' emphasizes that food procurement not interfere with the desired allocation of time or resources (Eide et al 1985).

weak labour force, social isolation) influence the range of strategies available to food insecure households and the degree of nutritional risk they experience. Preliminary to testing this hypothesis, Section 6.1 of this chapter considers the nature and organization of the household in Bamana society, and its appropriateness as a unit of analysis. In Section 6.2 an indicator of seasonal food insecurity is developed to classify households into groups of differing degrees of 'nutritional risk'. This classification scheme is applied to the Bèlèdugu sample to elicit some of the endogenous characteristics of households 'at-risk'. Section 6.3 considers the particular nature of household food insecurity in the village of Sèbèkoro using detailed seasonal data on household food consumption, nutritional status, cereal stocks flows, and expenditure. It investigates the endogenous nutritional and allocative characteristics of Sèbèkoro households which reflect both the desire and the ability of the household to obtain food seasonally. Section 6.4 summarizes the preceding analysis by commenting briefly on the adverse socio-economic outcomes of household nutritional risk.

Given the violation of assumptions which underlie the use of multivariate statistical techniques, analysis in this chapter is largely confined to simple parametric and non-parametric univariate and correlation statistics[2]. However, due to the inflated Type I error which occurs when multiple univariate tests are performed on correlated dependent variables, caution is required when interpreting significance. Where relevant, alpha levels are adjusted in proportion to the number of dependent variables in analysis to account for this error. In the case of seasonal data which are normally distributed, repeated measures analysis of variance is employed. Periodic reference is made to household case studies to illustrate and integrate some of these characteristics and how they relate to food security.

6.1 The Household as a Unit of Analysis

In Bamana society the household (*du*) is generally regarded as the locus of production, reproduction, consumption, and the basis of social, ceremonial and political interaction. Under the direction of the household head (*dutigi*), individuals coalesce in the task of assuring the

[2]Underlying multivariate procedures are the assumptions of multivariate normality, linearity (a straight line relationship between all pairs of variables) and homoscedasticity (that variability is the same for all variables) (Tabachnick and Fidell 1989:70-82).

subsistence needs of the collective household. All able household members are obliged to work the main domestic field, the produce of which is stored in a communal granary. The household head determines the daily ration of cereal drawn from this granary from one harvest to the next, as well as the domestic agricultural calendar; allocating time for private production to younger brothers and women in the household.

In view of these dynamics, the household is best defined as the collection of individuals who have rights to consume grain drawn from a common granary. This functional definition is preferable to one based on shared residence or blood kin given that it is not uncommon for household members to reside elsewhere in the village, or in the case of child fostering, to be unrelated by blood or marriage yet still be considered a member of the household. It implies a general pooling of subsistence resources, productive, and social obligations even though there may be individual control of livestock or other forms of wealth. The nature and organization of the Bamana household are amenable to a household focused analysis given the collective nature of subsistence production and consumption. However, this cooperative effort does not necessarily imply a commonality of interests or the egalitarian sharing of resources or work burdens.

In using the household as a unit of analysis, it is important not to obscure critical intrafamilial dynamics, divergences of interest, and imbalances of power between genders, generations, affines and kin. Although Hill (1972) acknowledges a certain degree of mutual dependence and complementarity in West African households, she contends that husbands and wives do not form a unified productive unit: despite the patriarchal bias in the distribution of resources, male and female budgets are separately controlled. The intergenerational tension between the desire of the household head to maintain household cohesion through his control over household assets and labour and the desire of children or younger brothers to receive their share of these assets, form independent households, and attain economic and social adulthood is another feature of Bamana and other agricultural societies (Goody 1958, White 1980:18).

A broader household-level approach will also take into account the existence of social networks of assistance and exchange between individuals and households which are critical to household survival (Chapter VIII). Similarly, analysis must be sensitive to the dynamic nature of the household. The ageing process, together with the biological and culturally determined processes of household recruitment (reproduction, in-marriage and fostering), and dispersal (mortality, out-marriage and fission) make the household a moving target in terms of its composition, structure, productive strength and consumption requirements over time (White 1980:19). In the analysis that follows, variables are developed which incorporate these dynamics given their possible import on household nutritional risk.

6.2 Seasonal Food Insecurity in the Bèlèdugu

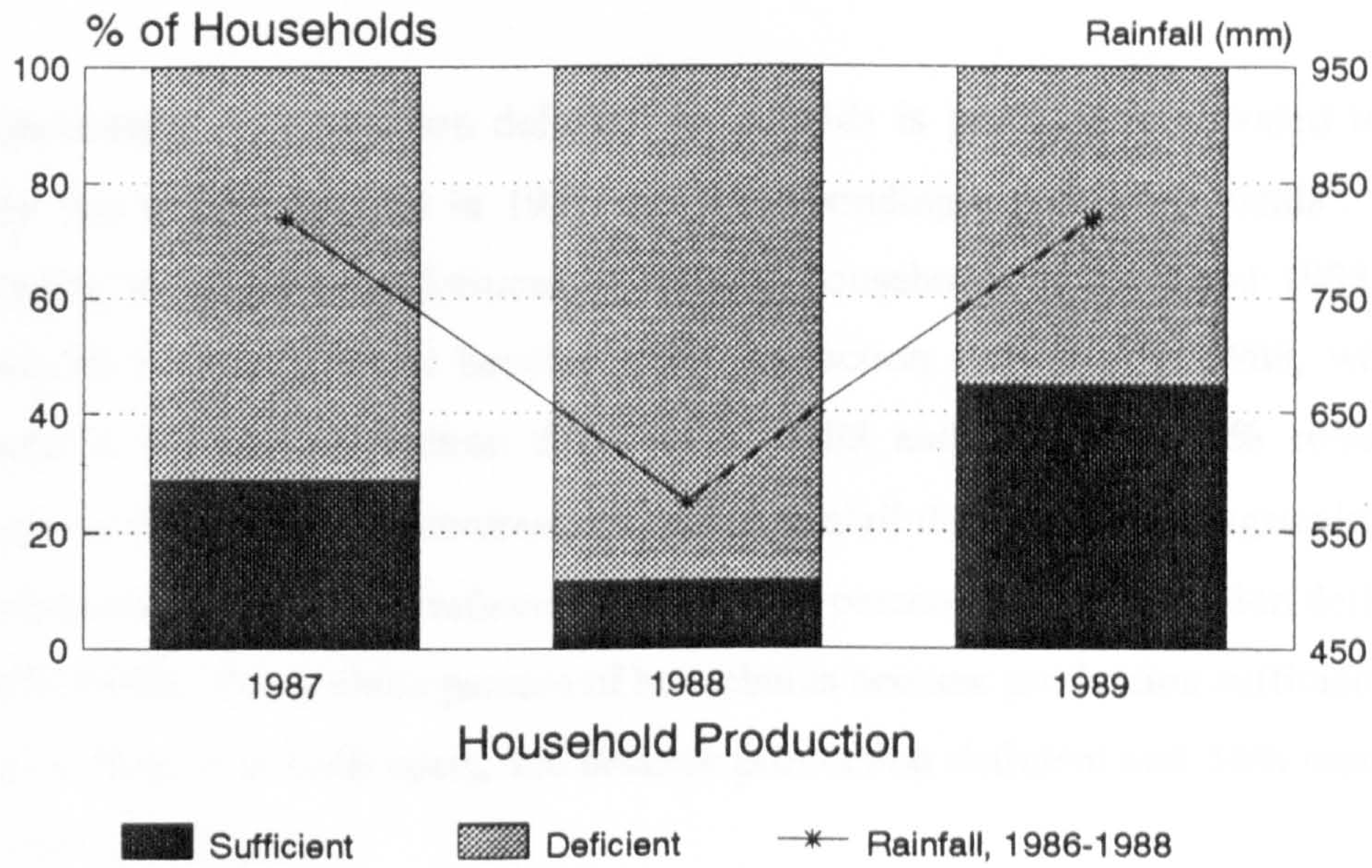
Like most of West Africa, the Bèlèdugu is characterized by extraordinary interannual, temporal and spatial variation in rainfall patterns. Of particular concern to semi-subsistence farmers is the irregularity of precipitation at the onset and termination of the agricultural season. Farm preparation, seed germination and crop growth are contingent on an adequate quantity, frequency and distribution of rainfall. Hence, to the extent that rainfall variability is a 'normal' phenomenon, and drought years recurrent and unpredictable, variable cropping fortunes are also expected.

This section considers variations in production sufficiency among Bèlèdugu households and indigenous explanations for this variation. It refines the concept of food insecurity by identifying adverse consumption events which mark increasing degrees of food insecurity. Bèlèdugu households are stratified according to this classification scheme and their endogenous characteristics compared in two consecutive yet contrasting years.

a) Production Sufficiency from 1987 to 1989

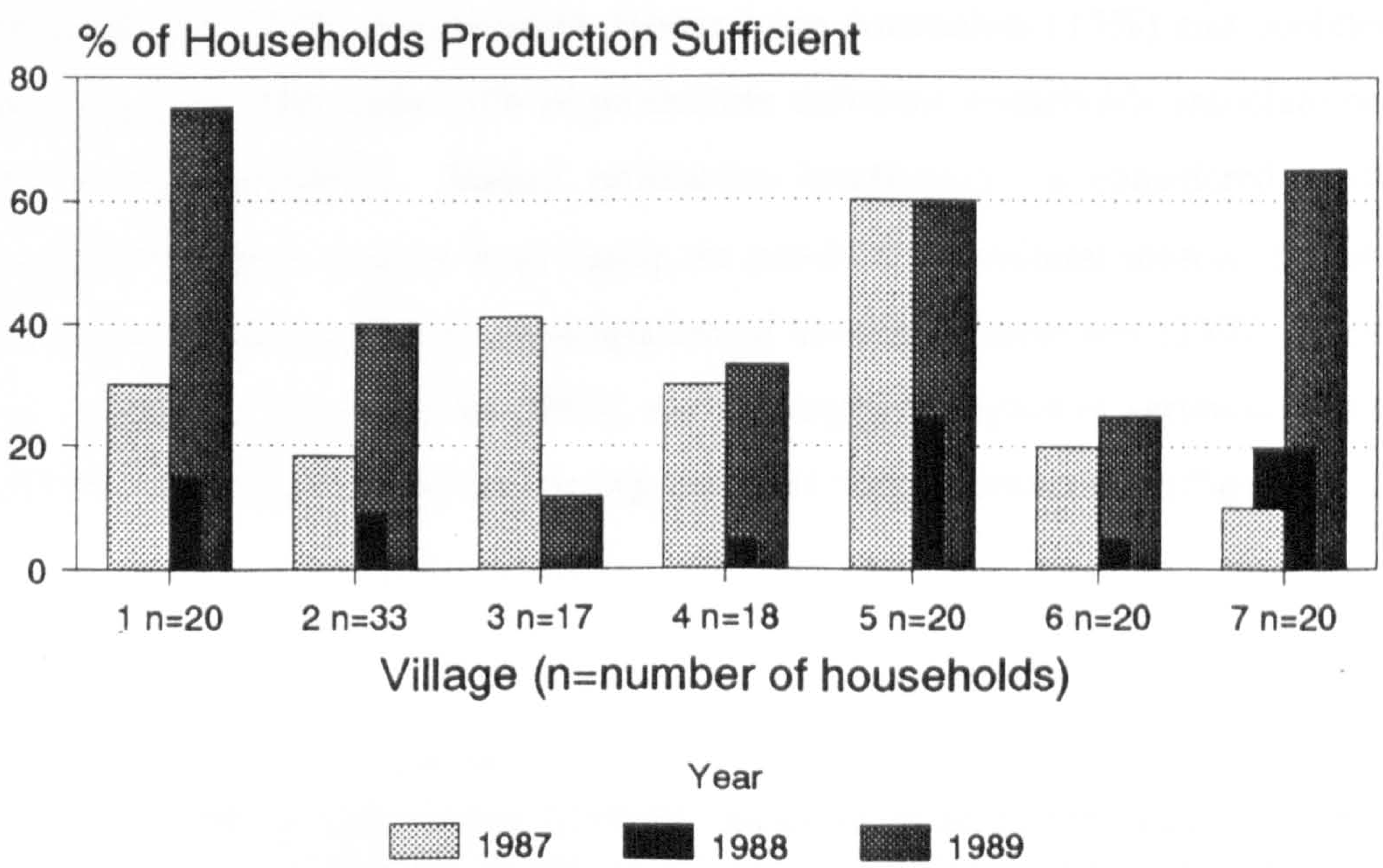
Figure 6.0 illustrates marked variation in the percentage of Bèlèdugu households able to meet annual consumption requirements through domestic production in three consecutive cropping seasons. Particularly striking is the correspondence between production sufficiency and mean annual rainfall in the region. Extreme intra-regional variation in production sufficiency is also apparent in Figure 6.1 which compares the percentage of production sufficient households among the seven villages which constitute the Bèlèdugu sample.

Figure 6.0 Household Production Sufficiency from 1987 to 1989



Beledugu, Mali, n=150 Households

Figure 6.1 Household Production Sufficiency by Village from 1987 to 1989



1=Kossumale, 2=Sebekoro, 3=Falakan, 4=Dubala, 5=Bala, 6=Fonfilebugu, 7=Zambugu

These variations are largely due to differences in: 1) climatic characteristics such as the timing, quantity, and distribution of rainfall; 2) bio-geographic features such as the fertility and elevation of farm land, or proximity to perennial rivers; and 3) socio-cultural characteristics relating to the value placed on agricultural production, out-migration and communal networks of exchange. The importance of these factors in determining the array of food security strategies available to households is explored later in Chapter VII.

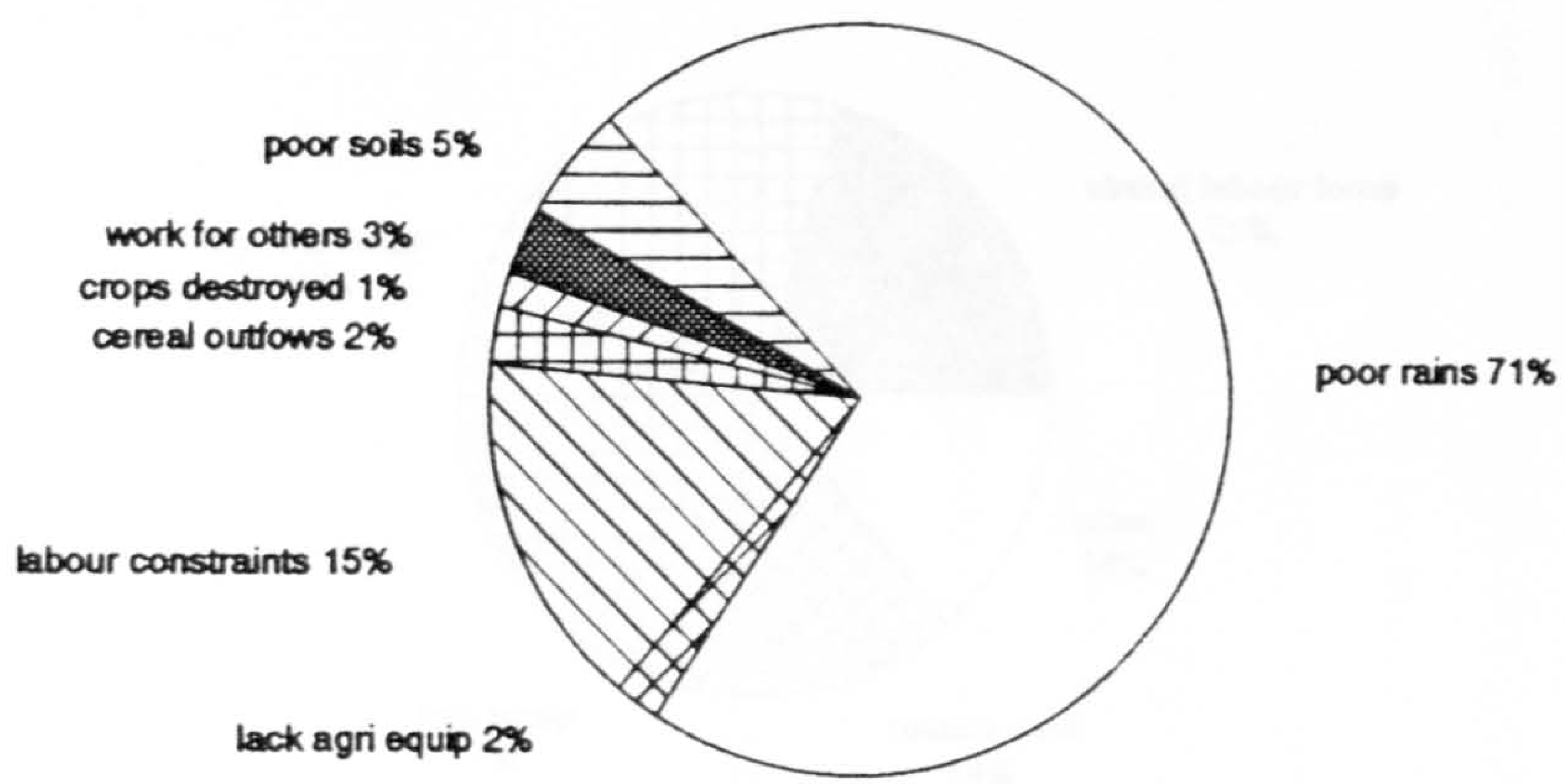
The percentage of production deficient households is particularly elevated in 1988 (87%), mainly due to poor rainfall in 1987 and correspondingly poor crop yields[3]. In fact, when comparing the production fortunes of specific households in 1987 and 1988, only 11% of households remain (5%) or become (6%) production sufficient in 1988, whereas 23% of households become production deficient in 1988 and a further 66% remain production deficient in both years. By contrast, improved rainfall during the 1988 agricultural season and better harvest prospects are reflected in a smaller percentage of production deficit households in 1989 (53%). Thirty-three percent of households become production sufficient in 1989, 10% remain sufficient in both years, 1% become production deficient and 56% remain production deficient in both years.

The critical importance of rainfall as a determinant of production sufficiency is confirmed by Figures 6.2 and 6.3 which summarize indigenous explanations for variable production fortunes in 1988 and 1989. In 1988, production deficit households attribute poor cropping fortunes to lack of rainfall (71% of responses), labour force constraints (15%) and depleted soils (5%). By contrast, in 1989, only 10% of production deficient households associate cereal shortage with insufficient rainfall. Rather, production insufficiency is considered a consequence of household efforts to procure food during the previous agricultural season. Exacerbated labour constraints due in part to the out-migration of household members (33%), cereal outflows to repay debts contracted in 1988 (29%), and the negative impact of agricultural wage-labour on domestic production (10%) are among the most cited explanations (Figure 6.2).

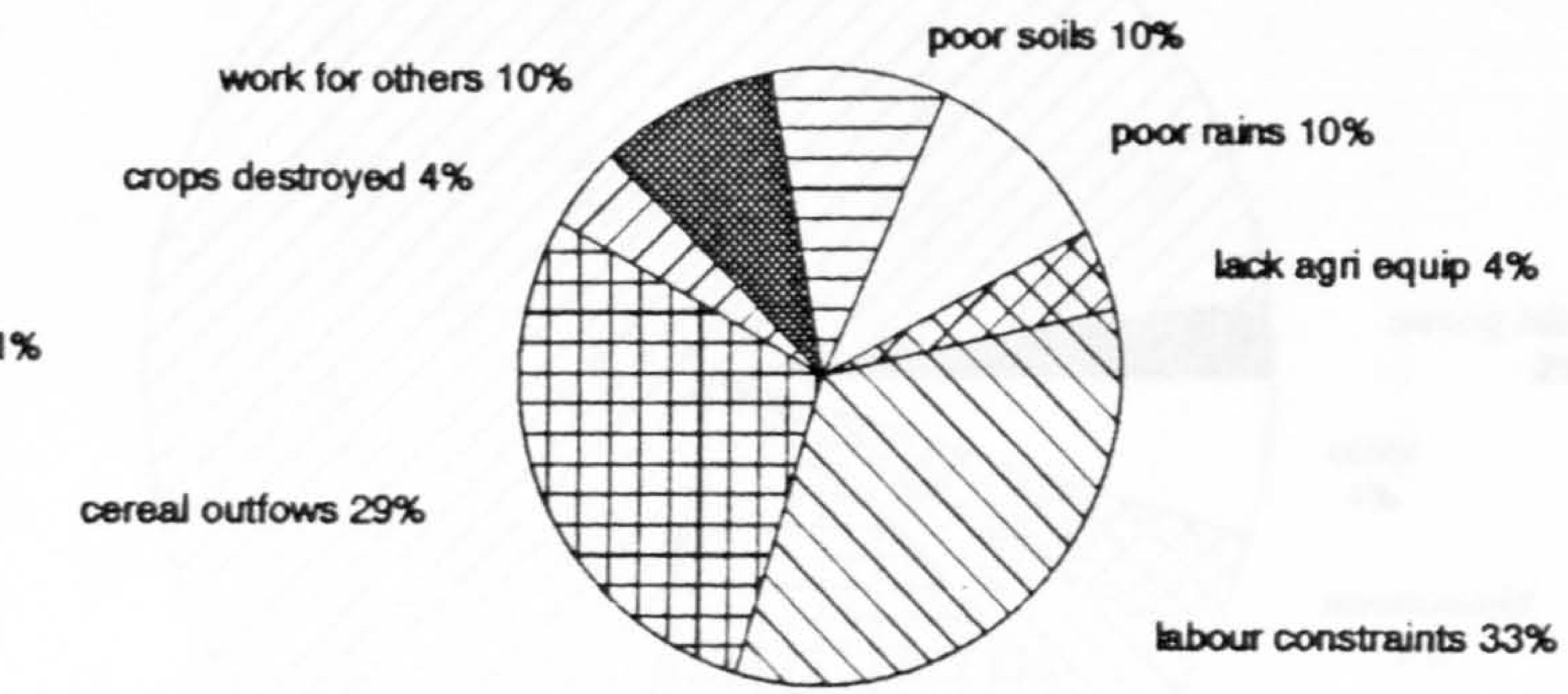
---

[3]During the drought period 1984-85, Reardon et al. (1988) state that less than 5% of households were production sufficient in village samples drawn from Sahelian and Sudano-sahelian zones of Burkina Faso.

Figure 6.2 Reasons for Production Deficiency in 1988 and 1989



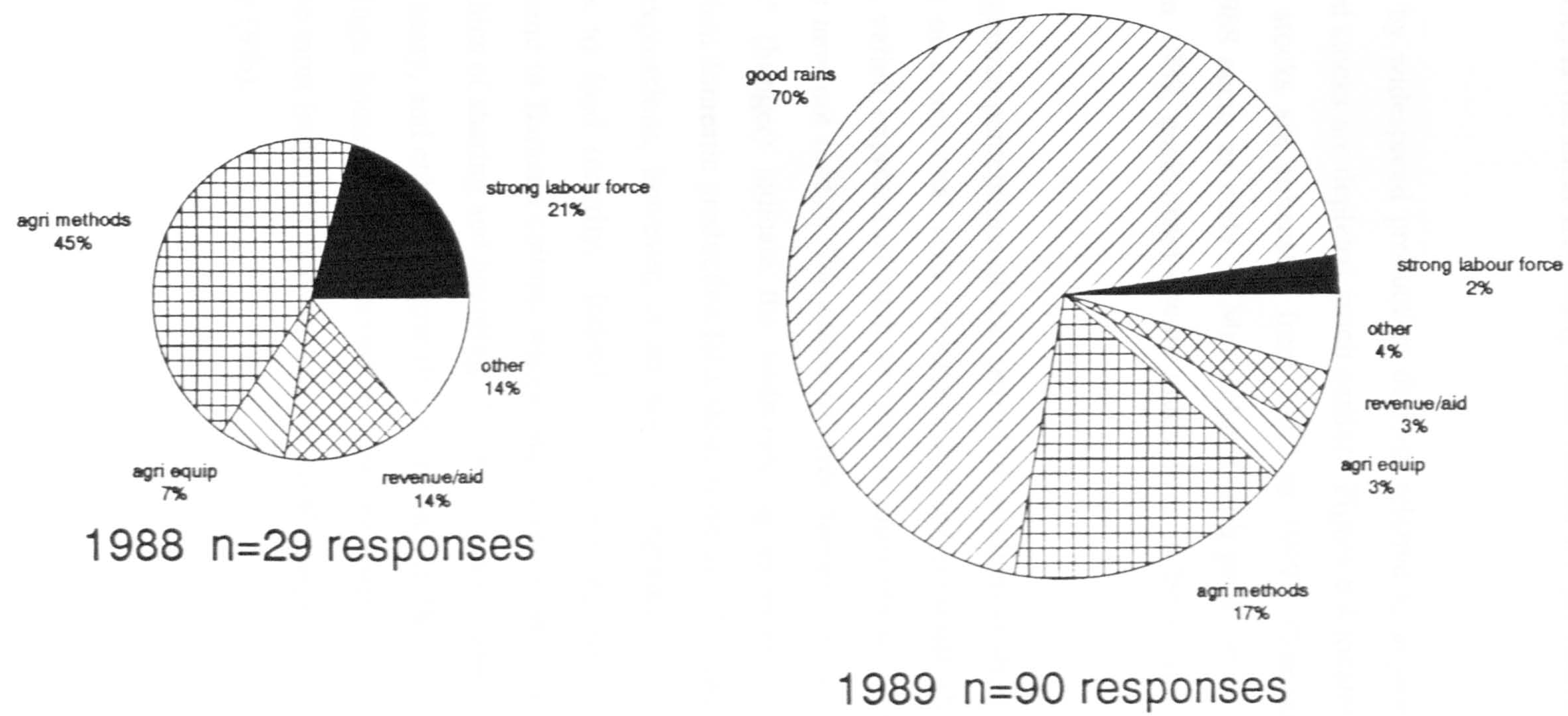
1988 n=203 responses



1989 n=116 responses

7 villages, Beledugu, Mali

Figure 6.3 Reasons for Production Sufficiency in 1988 and 1989



7 villages, Beledugu, Mali

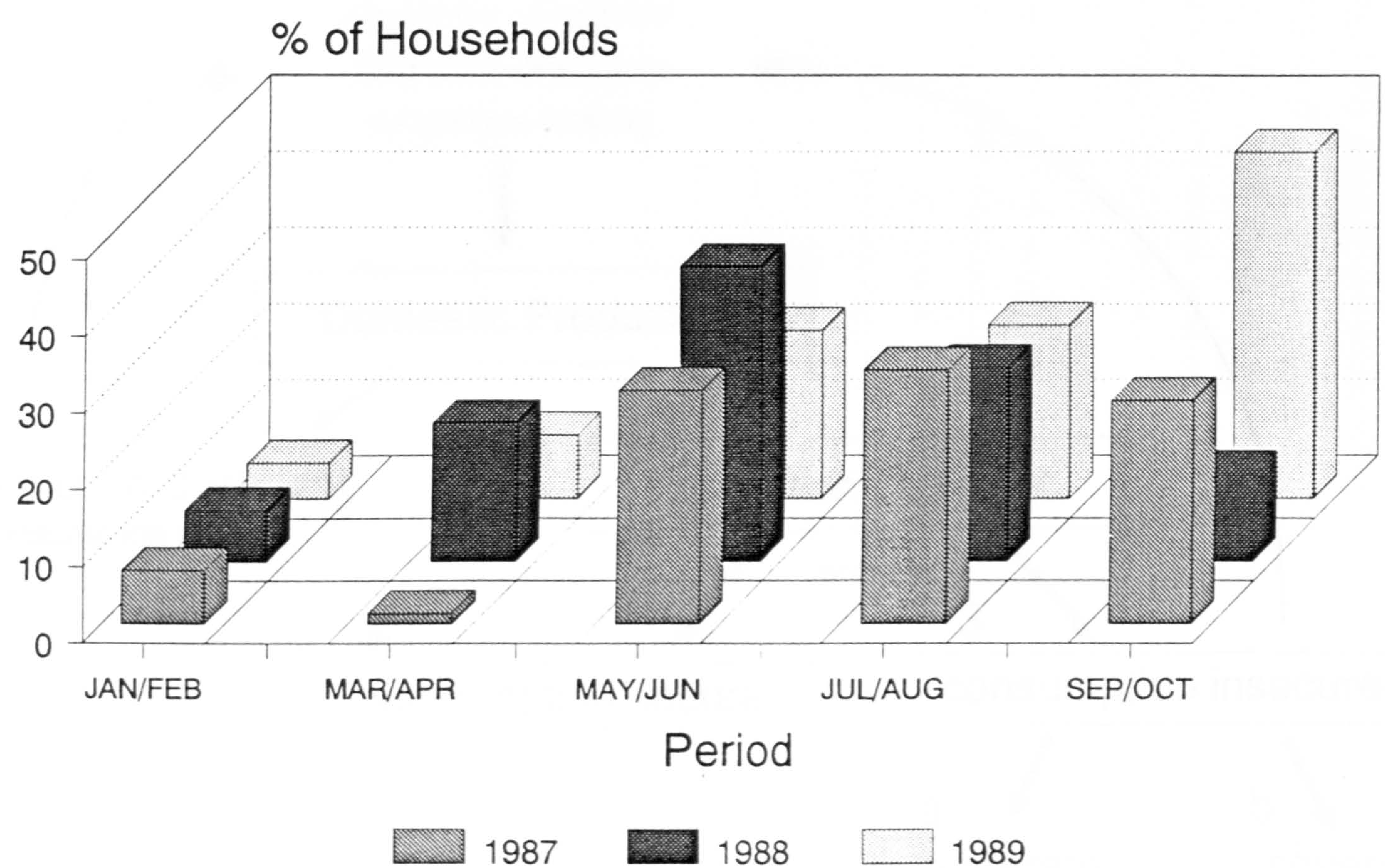
Production sufficient households, on the other hand, attribute favourable cropping fortunes in 1988 to agricultural advantages in terms of methods (45%), labour force (21%) and equipment (7%)[4]. Ample rainfall (70%) is the most frequently cited reason for production sufficiency in 1989 (Figure 6.3).

Not only is 1988 marked by widespread production deficits relative to adjacent years, but domestically produced food stocks are depleted much earlier. Figure 6.4 locates the moment at which household food stocks are exhausted from 1987 to 1989. Compared to 1987, production shortfalls in 1988 occur as early as March/April with peak onset in the period May/June. By contrast, in 1989, peak onset occurs much later in September/October just before the new harvest.

In attempting to elicit indigenous perceptions of this period of production shortfall, foremost was the apparent absence of a universal term or expression for seasonal shortage in the Bamana lexicon. Rather, varied expressions such as "*kur tè kura len tè*" (when the old harvest is finished and the new not ready), "*bu wulen kè*" (red faeces from consumption of wild foods), and "*kòngò*" (hunger) indicate the wide-ranging experience of individual households during years when domestic production falls short of household subsistence needs. Implicit in all of these expressions, however, is an acknowledgement of the threat that production shortfall poses to food security. Indeed, the underlying anxiety about food insecurity is a constant theme in Bamana culture; songs, myths and stories frequently focus on food scarcity and the ethics of sharing and hoarding. To the Bamana farmer, food security is embodied by the full granary, and enhanced agricultural production the means to this end. Accordingly, when Bèlèdugu households are asked to cite the elements fundamental to household food security, the most frequent response is agricultural equipment (61%), followed by food (19%) and money (9%).

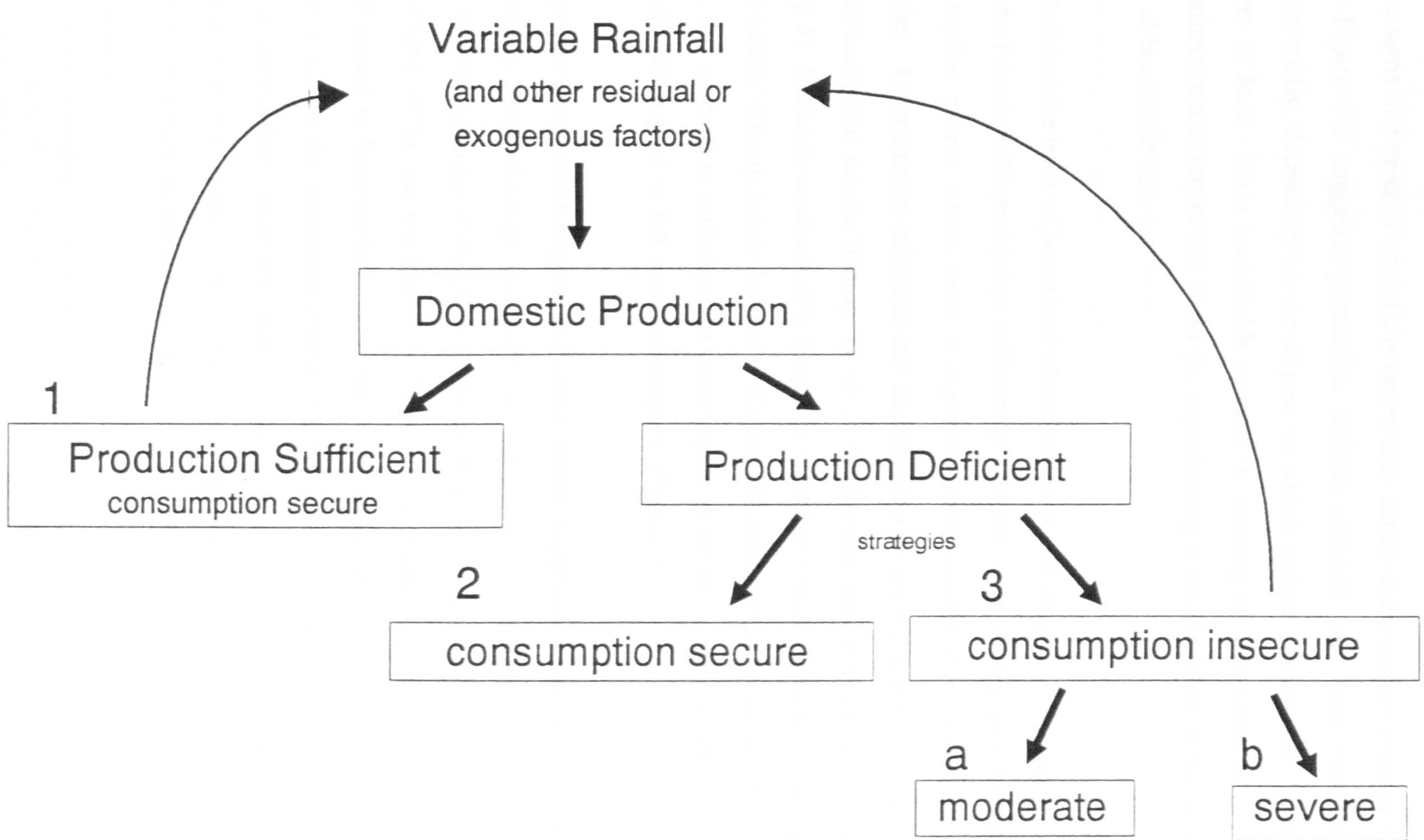
[4]Advantageous agricultural methods include planting at the right moment, agricultural 'savoir-faire', diversification of production, and well-placed fields.

Figure 6.4 Onset of Production Shortfall by Period from 1987 to 1989



Beledugu, Mali n=148 Households

Figure 6.5 Production Deficiency and its Differential Consumption Effects



b) Consumption Security as the Basis for Household Classification

While it may be that risk of food insecurity increases with the severity of production shortfall, it is wrong to assume that production deficits necessarily imply consumption insecurity. As the model in Figure 6.5 suggests, production deficits translate into food consumption insecurity differentially, depending on the degree to which deficit households can access alternate sources of food. Some households succeed in meeting the consumption needs of household members, while others fail to do so, experiencing a deterioration in the quantity and/or quality of household diet.

This distinction forms the basis of household classification in this chapter. With reference to both the degree of household production sufficiency, and the type, timing and duration of adverse consumption events which mark a departure from normal diet, households are classified as either: 1) production sufficient and consumption secure (Group 1); 2) production deficient and consumption secure (Group 2); or 3) production deficient and consumption insecure (Group 3). In certain analyses, this last group is further broken down into households which are 'moderately' (Group 3a), or 'severely' (Group 3b) consumption insecure. Although a fourth group, the production sufficient yet consumption insecure is theoretically possible, no sample households appear to fall into this category (Figure 6.5).

Three 'consumption events' which suggest qualitative and/or quantitative changes in household diet brought on by food shortage are used as indicators of consumption insecurity[5]. Reminiscent of the Aka pygmies of the Central African Republic (Bahuchet 1988), the Onicha Ibo of Nigeria (Ogbu 1973), and the Massa of Cameroon (de Garine and Koppert 1988), the staple (millet) is central to Bamana diet, and to their conception of satiety. A decrease in the amount of staple available for household consumption is culturally abhorred and tantamount to hunger. It is appropriate, therefore, that consumption events concern changes in the availability of the preferred staple, millet. The first of these events is termed 'wild foods'; a period in which foods such as the rhonier (*Borassus aegyptica*), da (*Hibiscus sabdariffa*),

[5]These categories resemble those proposed by Reardon et al. (1988), however, in their study a household is judged consumption insecure if average intake is 80% or below WHO requirements for a moderately active adult equivalent (2280 kcal) in two or more seasons. This empirically demanding methodology is considered impractical in the context of the present study.

wild tubers (*Cyperus esculentus, Sphenostylis stenocarpa*) or bran cous-cous and wild leaves are consumed exclusively. While less acute, the second event 'wild foods replace main meal', indicates cereal shortage which necessitates the substitution of wild foods for at least one of the two main meals. 'Rationing' represents the third and least severe of these consumption events. While the staple millet is consumed at all meal times, quantities are reduced as indicated by changes in the household cereal ration, or in the number of meals served.

Although households reporting one or more of these consumption events may be considered 'consumption insecure', additional criteria are applied to identify the 'severely' consumption insecure. The 'timing' of these consumption events is one such criteria. If an adverse consumption event occurs during the peak agricultural season from early July to mid-September, its impact on the household may be considered more severe than its occurrence in dry or rainy seasons.

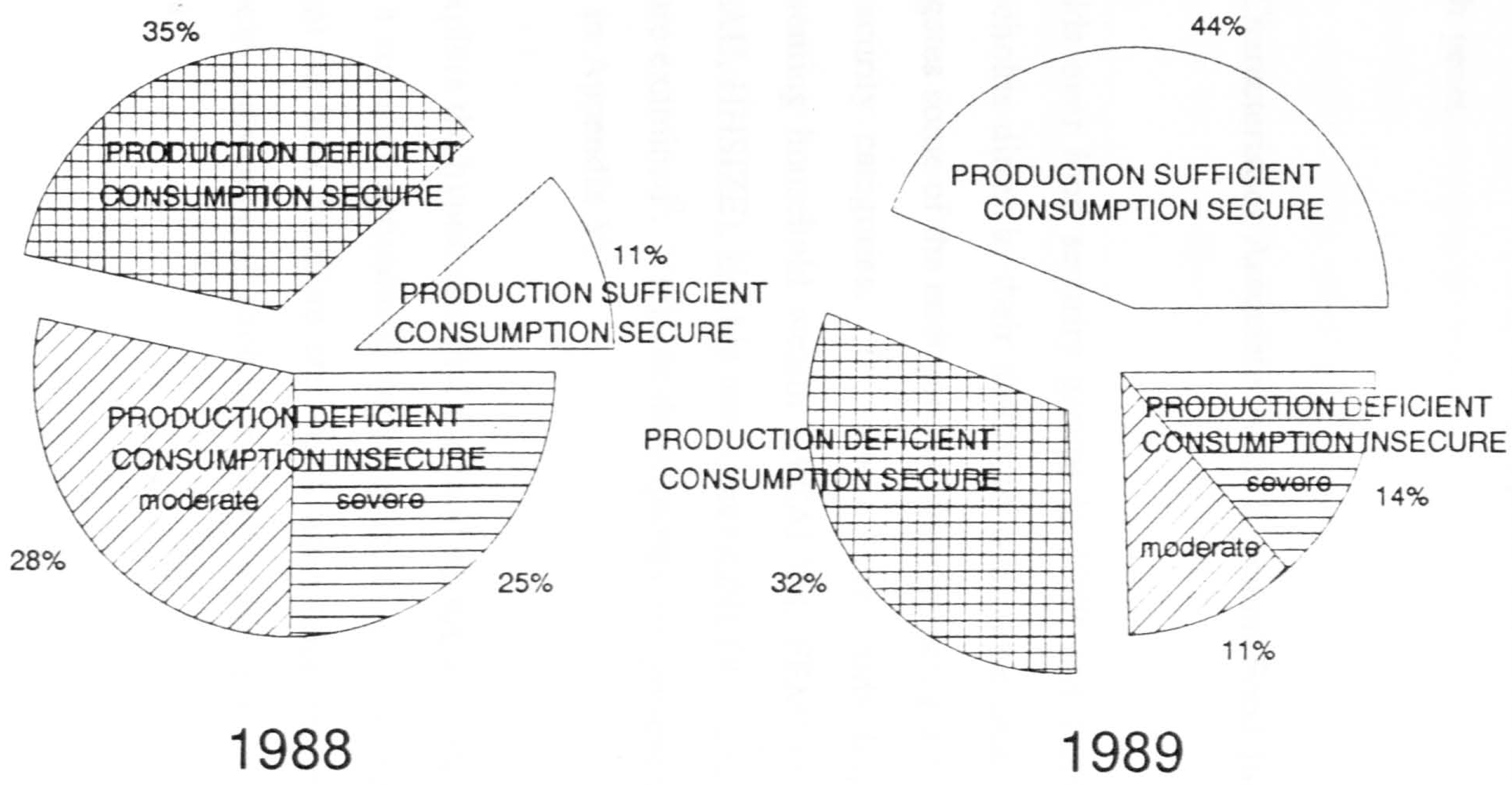
The reported 'duration' of consumption events also provides a means of assessing the degree of household food insecurity. Cut-off points are applied to the variable 'duration' such that households reporting: 1) wild food consumption on fewer than 5 days; or 2) a period in which wild foods replace the main meal for less than 10 days; or 3) rationing for less than 60 days are considered the 'moderately' consumption insecure (Group 3a)[6]. Households experiencing any of these events for a duration exceeding these cut-off points are considered the 'severely' consumption insecure (Group 3b). Households reporting production shortfall but no qualitative or quantitative changes to diet are assumed to be 'consumption secure' (Group 2) as are production sufficient households (Group 1).

When households in the seven village cross-sectional sample are stratified according to the above criteria, marked differences between 1988 and 1989 are apparent (Figure 6.6). In 1988, the percentage of households falling into the consumption insecure category (Group 3) is 53% compared to 25% in 1989.

---

[6]These cut-off points are derived arbitrarily based on the need for a minimum sample size in each group, and the subjective assessment of equivalence between the different consumption events in terms of the severity of food crisis i.e. wild foods >5 days = rationing>60 days.

Figure 6.6 Household Stratification by Degree of Consumption Security in 1988 and 1989



Beledugu, Mali n=148 Households

While the percentage of production deficient yet consumption secure households (Group 2) remains relatively unchanged from 1988 (35%) to 1989 (32%), a large increase in the percentage of production sufficient households (Group 1) occurs; rising from 11% in 1988 to 44% in 1989. With respect to the changing fortunes of specific households from one year to the next, 42% of households remain consumption secure in both 1988 and 1989, 34% become consumption secure in 1989, while 4% become consumption insecure, and 20% remain consumption insecure in both years.

c) Endogenous Household Characteristics Associated with Seasonal Food Insecurity in the Bèlèdugu

The distribution of households over food security groups in 1988 and 1989 suggests that irrespective of rainfall, households differ in their ability to overcome seasonal production deficits. This section investigates some of the endogenous characteristics which differentiate households between food security categories. In view of the study hypotheses being investigated, variables representing household wealth (WEALTH, FEMNO), demographic composition (SUMCU, SUMAU, HHSIZE), kinship networks (KINLOC), and lifecycle stage (DEPEND, AGE, HHAGE) are examined[7]. Variable descriptions are presented in Table 6.0, and their derivation outlined in Appendix V.

These variables are used to explore the hypothesis that the food secure are large, wealthy, and established households with a superior agricultural capacity relative to consumption needs. Conversely, it is proposed that the food insecure are small, asset poor, recently established households isolated from social networks of exchange, with a weak productive capacity relative to consumption needs.

[7]These variables are chosen given that they are amenable to measurement and relevent to the study hypotheses. However, it remains that unmeasured variables such as 'power', or the aptitude, motivation, efficiency of household members, will also influence household production and food security.

Table 6.0 Definition of Household Variables used in Cross-Sectional Analysis[1]

variable	description
WEALTH	wealth index based on the type of assets owned by the hhold
FEMNO	number of married women in the hhold
SUMCU	sum of consumption units approximating the consumption needs of the hhold
SUMAU	sum of activity units approximating the agricultural capacity of the hhold
HHSIZE	number of hhold members
KINLOC	index based on the number and the spatial and genealogical proximity of kin
DEPEND	hhold dependency based on the ratio of consumption units to activity units
HHAGE	age of hhold: whether newly, medium or long-established in village
AGE	age of hhold head

[1] Appendix V presents the derivation of these variables

i) wealth

Material wealth in Bamana society is difficult to quantify given the cultural censure of overt displays of affluence, and the tendency to exaggerate poverty in the presence of outsiders. For this reason, two variables are chosen to represent household affluence: an index of wealth based on an inventory of asset types owned by the household (WEALTH), and an indirect measure of wealth based on the number of married women in the household (FEMNO). Because unmarried women command a substantial brideprice in Bamana society, the presence of many married women in a household provides a proxy indicator of its relative purchasing power.

Mean variable values in 1988 and 1989 appear to support the hypothesis that household wealth is an important characteristic which differentiates between food security groups (Appendix VI: Tables 6.1a and b). This trend is particularly striking in the case of WEALTH; there being a consistent decline in mean index values with increasing food insecurity in both years.

Summarized in Table 6.2, one-way analysis of variance reveals significant group differences for wealth variables in both 1988 (WEALTH and FEMNO $p<0.001$) and 1989 (WEALTH and FEMNO p<0.01). Using Scheffe's procedure to perform pairwise comparisons of group means, significant differences are mainly found between production sufficient (Group 1) and production deficient households (Groups 2 and 3). However, when alpha levels are adjusted to take into account Type I error, group differences in 1989 lose their significance.

Table 6.2 Household Variables by Food Security Group in 1988 and 1989

	1988			1989		
variable	f-ratio or x^2!	p	Scheffe	f-ratio or x^2!	p	Scheffe
WEALTH	8.19	***	1 vs 3	6.71	**	1 vs 23
FEMNO	7.50	***	1 vs 23	5.84	**	1 vs 23
SUMCU	5.87	**	1 vs 23	4.35	*	1 vs 2
SUMAU	6.40	**	1 vs 23	5.31	**	1 vs 2
HHSIZE	5.21	**	1 vs 23	3.87	*	N/S
KINLOC	1.59!	N/S	N/A	1.45!	N/S	N/A
DEPEND	0.44!	N/S	N/A	4.33!	N/S	N/A
HHAGE	0.19!	N/S	N/A	1.27!	N/S	N/A
AGE	2.52	N/S	N/S	0.56	N/S	N/S

One-way analysis of variance: parametric= f-ratio; non-parametric Kruskal Wallis Test= x^2 N/A not available N/S not significant * p<0.05 ** p<0.01 *** p<0.001

Comparing the characteristics of production sufficient households in 1988 and 1989, mean wealth is greater in 1988 as severe and widespread production shortfalls permit only the very wealthy to remain in this group. However, with improved domestic production in 1989, the entry of moderately wealthy households into this group works to lower mean wealth values. In a similar fashion, the severely consumption insecure (Group 3b) also appear more affluent in 1988 as widespread production shortfalls result in a large influx of moderately wealthy households into this group. When cropping fortunes improve in 1989, mean wealth declines substantially as only the very poorest remain severely consumption insecure (Group 3b).

ii) demographic composition

Representing the demographic composition of the household are variables which approximate the consumption needs of the household (SUMCU), its agricultural capacity (SUMAU), and per capita size (HHSIZE). Tables 6.1a and b (Appendix VI) present mean variable values by food security group in 1988 and 1989 respectively. Summarized in Table 6.2, analysis of variance confirms the significance of trends toward more limited consumption needs, lesser agricultural capacity and smaller household size with increasing food insecurity in 1988 (SUMCU, SUMCU, HHSIZE $p<0.01$) and 1989 (SUMCU, HHSIZE $p<0.05$; SUMAU $p<0.01$). In both years, production sufficient households (Group 1) are significantly larger in terms of consumption needs, agricultural capacity and overall size than production deficient households (Group 2 and 3). However, Scheffe's procedure fails to detect significant differences between Groups 2 and 3. It should be noted, however, that when alpha levels are adjusted to take into account multiple univariate comparisons, these demographic trends lose their significance.

iii) kinship networks and lifecycle stage

Variables representing household kinship networks and lifecycle stage are presented together given their close relation in Bamana society. The variable KINLOC provides an index of the number, and the genealogical and spatial proximity of kin. Household lifecycle stage is indicated by three variables: the ratio of consumers to producers in the household (DEPEND), the length of time a household has been established (HHAGE), and the age of the household head (AGE). It is assumed that a household at a 'developing' lifecycle stage will have a less favourable dependency ratio, a less established presence in the village, and a younger household head than a 'mature' household at a more advanced lifecycle stage. Given its less established character, 'developing' households also tend to be more isolated from kinship networks.

As Tables 6.1a and b indicate (Appendix VI), production sufficient households (Group 1) may be characterized as more 'mature' in character, tending to have greater numbers of nearby kin, a more favourable dependency ratio, and elder household heads than production deficient households (Groups 2 and 3). Among production deficient households, the variables KINLOC and AGE seem to distinguish between food security groups. The severely consumption insecure (Group 3b) tend to be characterized by fewer nearby kin (KINLOC) and younger household heads (AGE) than Groups 2 and 3a, although these trends are not significant using one-way parametric and non-parametric analysis of variance (Table 6.2).

iv) a profile of household food insecurity

In sum, trends in variables representing the demographic and socio-economic composition of Bèlèdugu households seem to validate the hypotheses presented in Section 6.2. Production sufficient households (Group 1) appear structurally distinct from production deficient households (Groups 2 and 3). They are significantly more wealthy (WEALTH, FEMNO), larger in size (HHSIZE), with correspondingly greater consumption requirements (SUMCU) and agricultural capacity (SUMAU). Non-significant trends suggest that production sufficient households (Group 1) tend to be longer-established in the village as indicated by their greater proximity to kinship networks (KINLOC), a more favourable dependency ratio (DEPEND), and the senior status of their respective household heads (AGE). The intergenerational character of the production sufficient household makes it less vulnerable to crises in reproduction, while providing members with the productive advantages of an economy of scale, and protection from individual-specific risk such as the loss of labour due to illness (Binswanger and McIntire 1987:82). Indeed, based on the comparison of group characteristics in 1988 and 1989, it may be argued that greater wealth and size predispose these households to seasonal food security in both good years and bad.

In contrast, food insecure households (Group 3), are significantly poorer (WEALTH, FEMNO) and smaller in size (HHSIZE), consumption requirements (SUMCU) and agricultural capacity (SUMAU) than production sufficient households (Group 1). The food insecure tend to be less established in the village as indicated by fewer numbers of nearby kin (KINLOC), less favourable dependency ratios (DEPEND) and the junior status of household heads (AGE). As group characteristics from 1988 and 1989 attest, chronic seasonal food insecurity is largely the experience of the smallest and the poorest of these households.

The blurred distinction between production deficient households (Groups 2 and 3) is most probably a function of the variability of rainfall and cropping fortunes described in Section

6.2a. Depending on the adequacy of rainfall the previous cropping season, Group 2 households move to and from the ranks of the consumption insecure (Group 3). In 1988, when poor rainfall resulted in widespread cereal deficits, a generalized movement of households from Group 2 to food insecure Groups 3a and b is apparent. An opposite movement occurs in 1989 when cropping fortunes improve. This interannual movement between groups precludes the clear identification of characteristics which differentiate production deficient households. Although there appears to be some deterioration in the variables WEALTH and KINLOC with increasing food insecurity, these differences are not significant. The degree to which differential access to wealth and kinship networks influences the strategies adopted by food insecure households is pursued further in Chapters VII and VIII.

In addition to being strongly associated with greater household food insecurity, the variables WEALTH, FEMNO, SUMCU, SUMAU, and HHSIZE are highly correlated with one another (Table 6.3). This bivariate collinearity suggests that these variables are not independent predictors of household food security, but rather represent a locus of inter-related characteristics which distinguish between food security groups.

Table 6.3 Matrix of Bivariate Correlations between Household Variables in the Bèlèdugu, Mali: 148 households, 7 villages

	WEALTH	FEMNO	SUMCU	SUMAU	HHSIZE	KINLOC	DEPEND	AGE	HHAGE
WEALTH	1.00								
FEMNO	0.52**	1.00							
SUMCU	0.56**	0.90**	1.00						
SUMAU	0.56**	0.88**	0.98**	1.00					
HHSIZE	0.56**	0.89**	0.99**	0.96**	1.00				
KINLOC	0.21*	0.20*	0.18	0.19*	0.17	1.00			
DEPEND	-0.04	0.03	0.04	-0.10	0.01	-0.07	1.00		
AGE	0.18	0.23*	0.17	0.17	0.17	0.09	0.05	1.00	
HHAGE	0.19	0.26**	0.30**	0.31**	0.29**	0.33**	-0.04	0.06	1.00

Pearson product moment correlation with one-tailed probabilities: * $p<0.01$ ** $p<0.001$

In conclusion, while rainfall is a critical determinant of the scope and severity of seasonal food insecurity, study findings support the hypothesis that the endogenous characteristics of the Bamana household also influence the degree of risk it experiences. This finding is underlined by indigenous views on factors provoking seasonal food insecurity. In a bad year, represented by data from 1988, lack of rainfall was the universal response. By contrast, in a good year, represented by data from 1989, endogenous factors such as labour constraints and a lack of agricultural materials were the most frequently perceived factors provoking food insecurity. Of course, it is difficult to posit the direction of causality between these endogenous characteristics and food insecurity for each influences the other: just as poor households are may be unable to sustain the strong productive base necessary to remain food secure, food insecure households may find themselves caught in a downward spiral of poverty and indebtedness.

6.3 Seasonal Food Insecurity in Sèbèkoro

This section uses seasonal data collected in the village of Sèbèkoro to explore further the demographic, socio-economic, nutritional and allocative characteristics of household food insecurity. First, Sèbèkoro households are analyzed according to the structural variables developed in Section 6.2 to assess how closely Sèbèkoro resembles the profile of food security developed in the larger Bèlèdugu sample. Second, the endogenous characteristics of food security groups will be reexamined using variables collected in the longitudinal study. These variables are assumed to be more sensitive and precise given the detailed and continuous nature of data collection. Third, variables representing household health and nutrition are developed to investigate seasonal differences in nutritional status between food security groups. Finally, the seasonal allocative behaviour of households with respect to cereal stocks and money expenditure is examined to discern any differences which may be related to food insecurity. Throughout this discussion, the Sèbèkoro sample is analyzed according to the classification scheme outlined in Section 6.2c.

a) Endogenous Household Characteristics Associated with Seasonal Food Insecurity in Sèbèkoro

To assess how closely Sèbèkoro resembles the profile of food insecurity developed in Section 6.2, the sample is first analyzed according to the household variables used in the cross-sectional analysis. Found in Appendix VI, Table 6.4 summarizes mean variable values by food security group, and between group differences using one-way analysis of variance. Significant group differences are found for the variables WEALTH ($p<0.01$), FEMNO ($p<0.0001$), SUMCU, SUMAU ($p<0.01$), and HHSIZE ($p<0.05$), although this significance is lost when alpha is adjusted to take into Type I error. Using non-adjusted alpha levels, Scheffe's Procedure locates this significance between production sufficient (Group 1) and production deficient households (Groups 2 and 3). No significant structural differences are apparent within the production deficient group which may be due to marked interannual movement between food security groups which obscure group differences. One-third of households falling into the consumption secure group in 1989 (Group 2) were consumption insecure in 1988 (Group 3).

Based on longitudinal survey data, some of the variables developed in the cross-sectional survey are refined to better capture group differences. Table 6.5 briefly describes the variables used in this analysis while Appendix V outlines the manner in which they were derived.

Table 6.5 Definition of Household Variables used in Longitudinal Analysis[1]

variable	description
ASSETS	monetary value of hhold assets expressed per capita
LIVESTOCK	monetary value of hhold livestock holdings expressed per capita
AGRIEQUIP	monetary value of hhold agricultural equipment expressed per capita
FEMNOS	number of married women in the hhold
CU	sum of consumption units approximating the consumption needs of the hhold
AU	sum of activity units approximating the agricultural capacity of the hhold
PC	number of hhold members
VILLKIN	index based on the number and the spatial and genealogical proximity of kin
DEPEND	hhold dependency based on the ratio of consumption units to activity units
HHAGE	age of hhold: whether newly, medium or long-established in village
AGE	age of hhold head

[1] Appendix V presents the derivation of these variables

i) wealth

The variable WEALTH is replaced by three variables which more accurately reflect the nature and magnitude of household material and productive assets (ASSETS, LIVESTK, AGRIEQ). Table 6.6 (Appendix VI) indicates a gradation of material wealth in favour of production sufficient households (Group 1) in terms of net assets (ASSETS), and assets broken down by type (LIVESTK, AGRIEQ). However, substantial variation in ownership within each group precludes any statistical significance. Just as the traditional household #204 is without assets yet a member of Group 1, household #225 is asset rich (Group 2), yet unable to attain production sufficiency. Although household #225 possesses substantial livestock holdings and agricultural equipment, domestic production is constrained by its limited agricultural labour capacity.

ii) demographic composition

Demographic variables representing household consumption needs (CU), agricultural capacity (AU), and per capita size (PC) improve equivalent cross-sectional variables by taking into account seasonal population dynamics. As found in the cross-sectional survey, production sufficient households (Group 1) have significantly higher mean demographic variable values than food security Groups 2 or 3 in every season ($p<0.05$), although this significance is lost when adjusting for Type I error (Table 6.6 Appendix VI).

iii) kinship networks and lifecycle stage

Genealogical detail on household origins and kinship networks permits the refinement of household variables which approximate the extent of intra-village kinship networks (VILLKIN) and household age (AGEHH). While higher mean values among production sufficient households (Group 1) suggests that this group has greater access to intra-village kinship networks than Groups 2 or 3, this difference is not significant. However, as Table 6.6 indicates, significant group differences in household age are detected; production sufficient households (Group 1) tending to be longer-established than production deficient households (Groups 2 and 3).

b) Household Nutritional Characteristics Associated with Seasonal Food Insecurity in Sèbèkoro

Seasonal variables representing household food consumption, condiment diversity, aggregate household nutritional status, and the nutritional status of age and gender groups within the household are used to investigate the nutritional implications of household food insecurity (see

Appendix V). As Table 6.7 (Appendix VI) summarizes, when mean household energy and nutrient intake are analyzed by food security group, no significant differences are detected in any season. Repeated measures analysis of variance also fails to identify a group effect on seasonal variation in energy and nutrient intake. Similarly, no significant differences in condiment diversity between food security groups are found, nor is a significant group effect on seasonal variation in condiment diversity discerned using repeated analysis of variance.

The lack of significant group differences in household food intake is corroborated by the absence of significant group differences in both age and gender and aggregate household anthropometric scores. Referring to Table 6.7 (Appendix VI), only among children under five years of age does univariate analysis reveal significant group differences, with more favourable nutritional scores registered in food sufficient households ($p<0.05$). However, when analyzed seasonally, this significance is only located in the dry season. Using Scheffe's procedure to partition variance between specific groups, significant differences are located between the production sufficient (Group 1) and consumption insecure households (Group 3) in particular ($p<0.05$).

Of the 5 households forming the consumption insecure group (Group 3), 3 households (#405, #217, #221) have severely malnourished scores (1.0) for children under 5 years of age , while the remaining 2 households have no children of this age. This is compared to 1 of 12 households in Group 1, and 4 of 17 households in Group 2 which possess severely malnourished scores for children in this age range.

As regards seasonal variation in aggregate household anthropometric scores, households with net nutritional scores of 2.5 or below are more numerous in the rainy season (15 households) compared to harvest (9 households) or dry (11 households) seasons. Of these 15 households, 10 had similar scores in at least one other season. Considering households by food insecurity group, 50% of production sufficient households (Group 1) have net nutritional scores of 2.5 or below, compared to 40% for consumption insecure households (Group 3). As expected, repeated measures analysis of variance fails to detect a significant group effect on seasonal variation in aggregate household anthropometric variables.

In sum, it appears that household food insecurity has only a limited association with the nutritional status of its members in the year of study: the only evidence being the association between the nutritional score of children under 5 and household consumption insecurity in the dry season. The nature of the data does not permit the identification of particular factors which might explain the transient drop in child nutritional score, i.e. whether it is due to insufficient consumption or due to other events in the food insecure households such as illness or weaning.

The absence of association between household nutritional risk and household food security is further highlighted when profiles of households with the ten lowest anthropometric scores are considered (Table 6.8).

Table 6.8 Characteristics of Households with the 10 Lowest Anthropometric Scores in Sèbèkoro

#	# hhold	anthro score	fd secure group	hhold size	assets (FCFA)	illness days
1	204	1.83	1	6	9170	4
2	221	2.14	3	8	29700	10
3	207	2.20	1	14	4120	9
4	205	2.23	3	14	29470	12
5	225	2.33	2	23	112750	8
6	219	2.33	2	6	18950	8
7	232	2.33	2	5	1680	29
8	211	2.36	1	16	64980	5
9	209	2.40	1	27	43230	22
10	224	2.46	1	15	154120	15

Household #204 possesses the lowest household anthropometric score, despite being production sufficient and healthy, which may be a consequence of the 'genetic smalless' of both parents. Household #221, on the other hand is consumption insecure, despite having greater assets than household #204. Given that both adult members have high nutritional scores, the low household anthropometric score reflects the severe malnutrition in younger household members. Household #207 is production sufficient, medium sized, yet asset poor while #205 is consumption insecure, medium sized and has a moderate level of assets.

Contrasts are also evident between household #232 which is a small, asset poor and unhealthy, and #209 which is large, moderately wealthy and unhealthy. The heterogeneity of the household population in terms of food security status, anthropometric scores, and number of illness days, emphasizes the lack of a clear association during the year of study.

In the absence of group differences for the majority of nutritional variables, associations with other structural characteristics are explored using Pearson product moment correlations. Significant negative correlations are revealed between household size and both energy ($r=-0.56$) and nutrient intake ($r=-0.55$) ($p<0.001$). Indeed, if households are classified as either small (<10 members) or large (10 or more members), one-way analysis of variance reveals significantly greater energy and nutrient intake per consumption unit among smaller households ($p<0.0001$).

However, with the exception of children aged 5-15 years, low energy and protein intakes among large households are not reflected in household nutritional scores. The consistent finding of low nutritional scores among the 5-15 year age group ($p<0.01$) may reflect the inability of large households to satisfy the high energy requirements of many growing children. A correlation between low energy intake in large households and low nutritional scores in children aged 5-15 in every season ($p<0.01$) further supports this hypothesis.

A number of explanations may be entertained as to why small households appear to be better off nutritionally, yet at greater risk to food insecurity. First, although higher intakes are recorded in small households, household food consumption measurements may not have coincided with the period of greatest consumption stress. However, the fact that significant differences between large and small households are evident in every season makes this hypothesis unlikely.

Second, food measurement techniques may underestimate intake among large households by failing to capture the full extent of extra-mealtime consumption among numerous household members. However, similar associations between household size and energy and nutrient intake have been observed in other food consumption surveys in West Africa (Mondot Bernard 1980, Toulmin 1986, Delisle et al. 1991). While methodological biases toward small households may also flaw these studies, the consistency of these findings suggests otherwise.

Third, it may be that by virtue of their size, small households eat more condiments than large households. When household consumption is broken down into cereals and condiments respectively, significant group differences are apparent in the rainy season for cereals ($f= 7.45$ $p<0.01$) and in the harvest and dry seasons for condiments (har $f=4.79$ $p<0.05$; dry $f=4.31$ $p<0.05$). Small households consume significantly more cereals (2064 kcal) than large households (1881 kcal) in the rainy season, and more condiments in the harvest (small 925 kcal; large 710) and dry seasons (small 496 kcal; 497 kcal).

Finally, these results may suggest that although large households appear to eat less, unlike small households, this level of consumption is more secure from one year to the next. Because the year of measurement happened to be a good one, small households were able to sustain a high level of intake for all but a brief period of shortage prior to the new harvest which did not happen to coincide with rainy season measurements. Were this a bad year, however, it might be hypothesized that consumption levels in this group would plummet far more dramatically than large households. While it is impossible to test this hypothesis given the absence of nutritional variables collected during a 'bad' year, this explanation is probably the most plausible. Whatever the explanation, it is unwise to assume that measures of nutritional risk among age and gender groups within the household and measures of household food insecurity necessarily represent proxies of one another.

c) Household Allocative Behaviour Associated with Seasonal Food Insecurity in Sèbèkoro

Thus far the association between household food insecurity and static demographic and socio-economic variables has been investigated. This section addresses the more dynamic character of household food security by examining whether food insecure households exhibit common behaviours in the allocation of scarce cereal and monetary resources.

Figure 6.7 Annual Household Cereal Inflow per Consumption Unit by Source

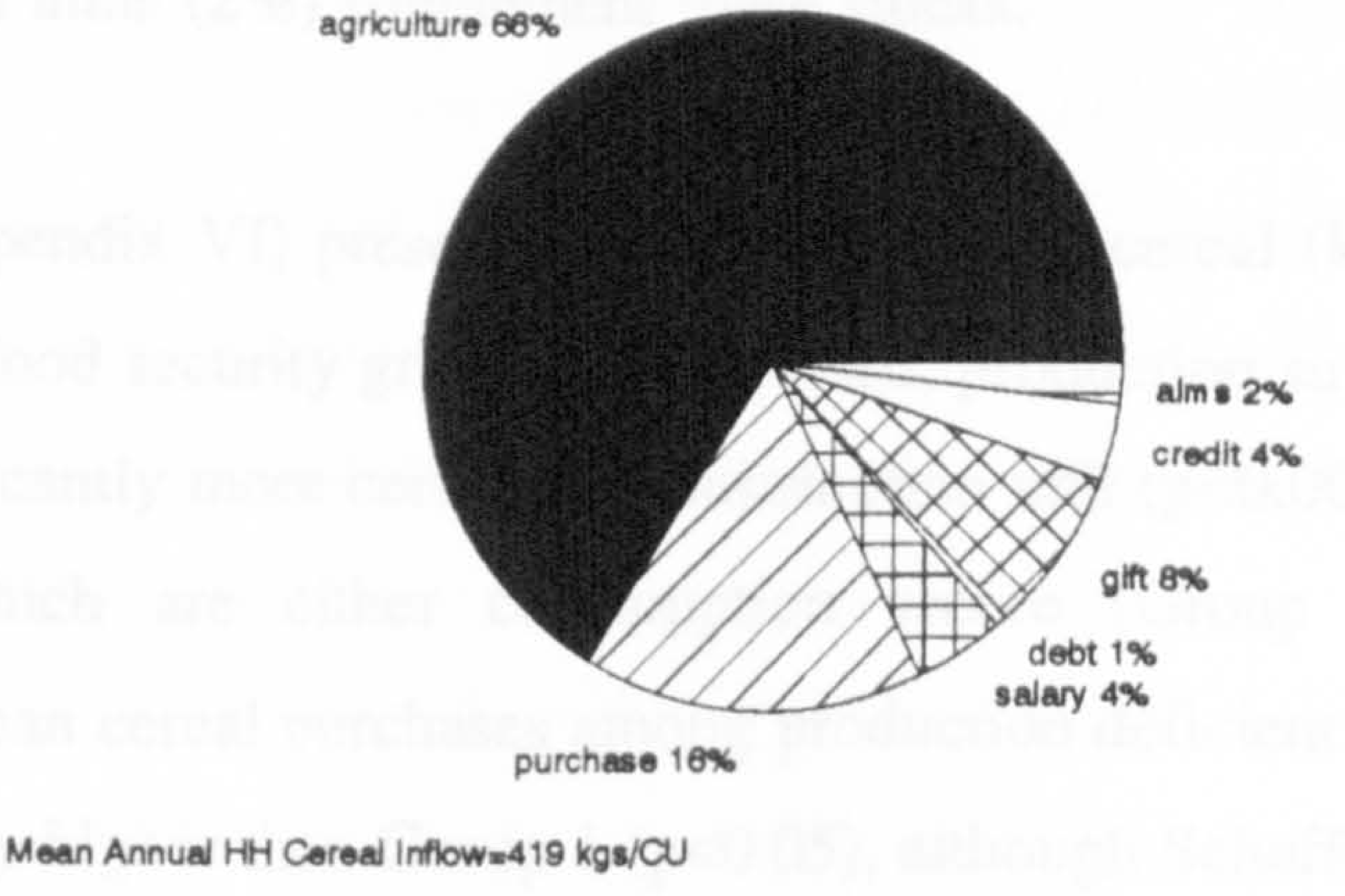


Figure 6.8 Annual Household Cereal Outflow per Consumption Unit by Destination

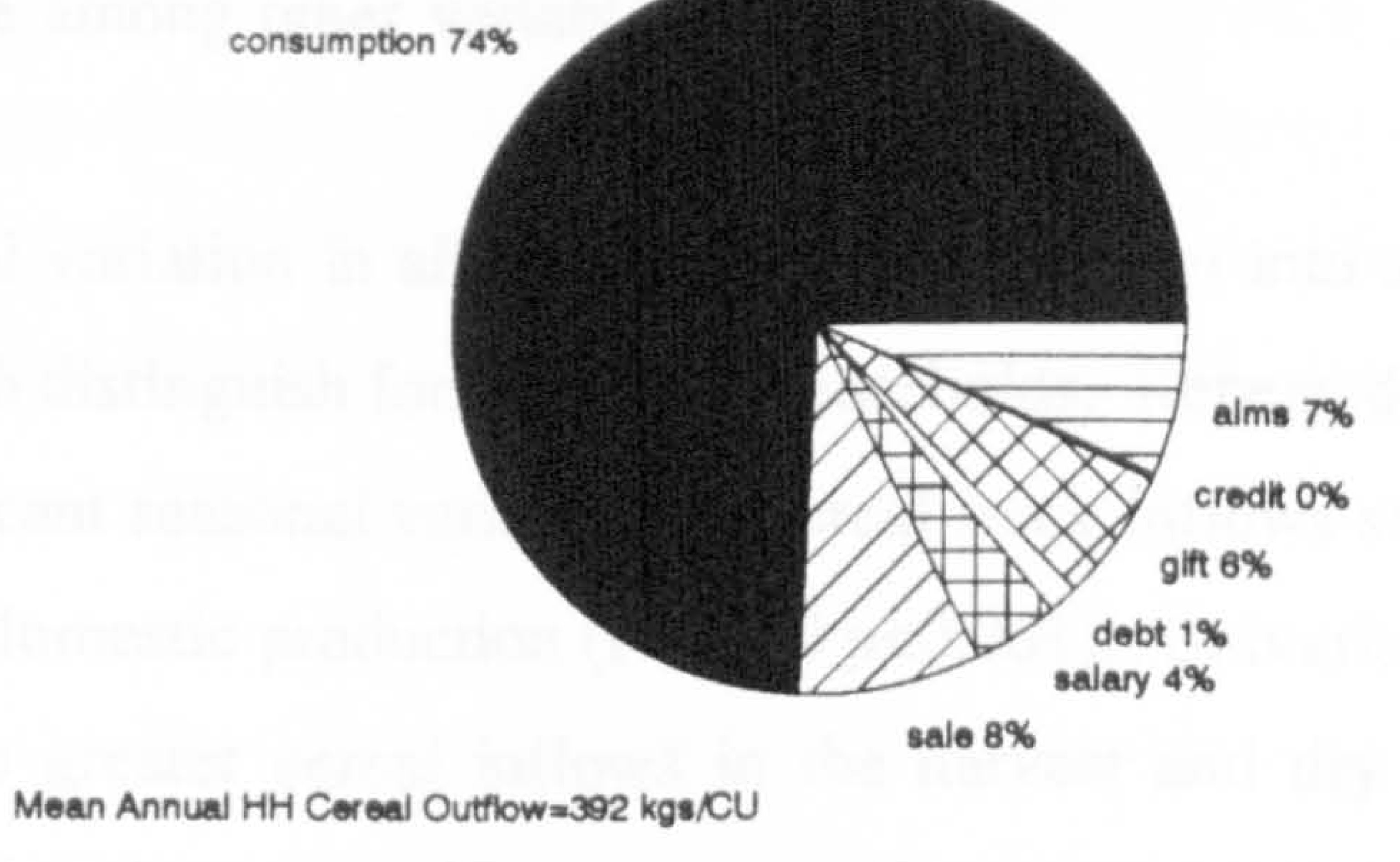
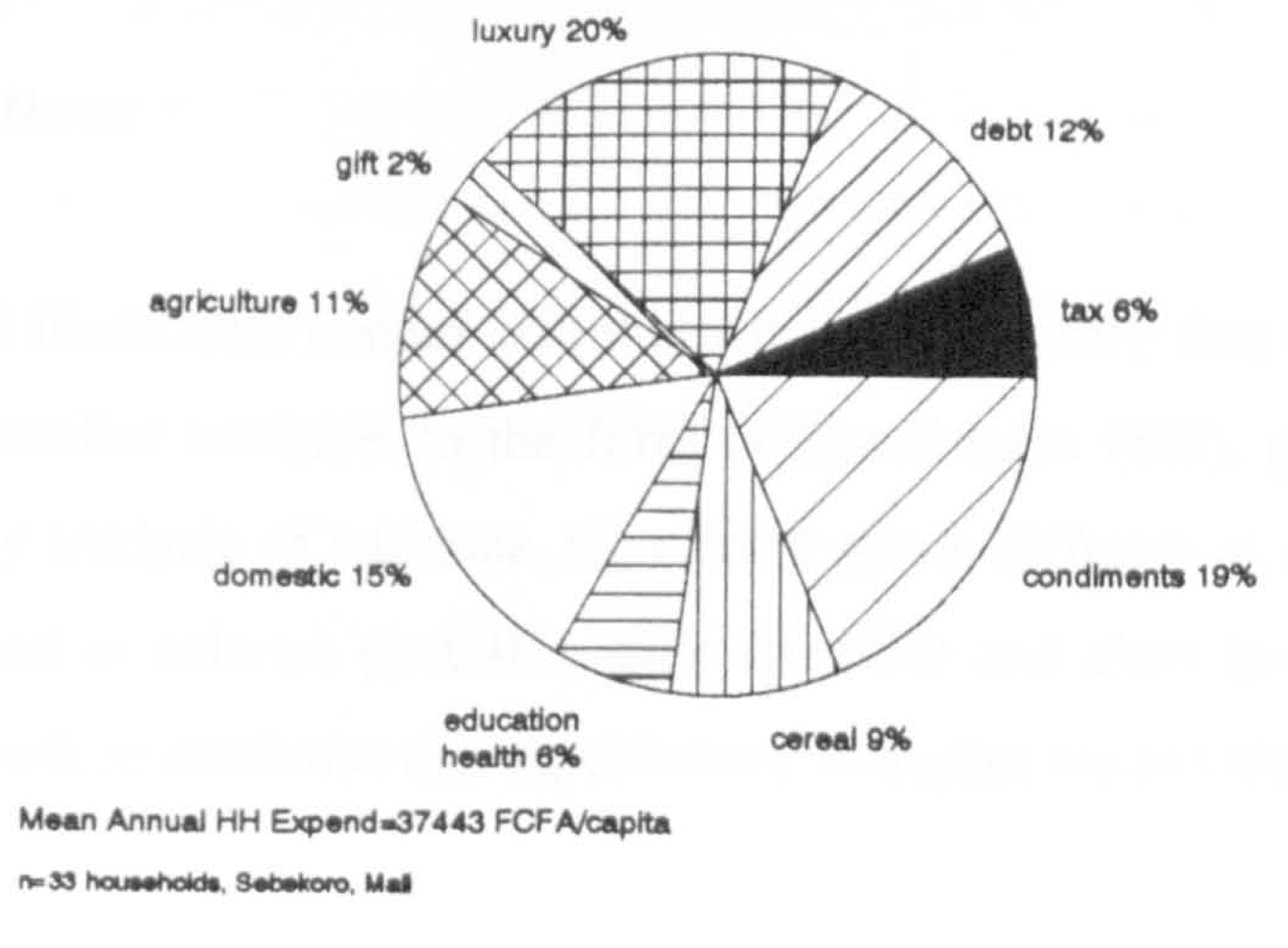


Figure 6.9 Annual Household Expenditure Per Capita by Category



i) cereal inflows

In Sèbèkoro, household cereal stocks are mainly comprised of domestically produced millet (66%) and market purchases (16%). As Figure 6.7 illustrates, cereal inflows such as millet salaries paid to women who winnow the new crop (4%) and the receipt of millet credits (4%), gifts (8%), and alms (2%) supplement these stocks.

Table 6.9 (Appendix VI) presents mean quantities of cereal (kg/cu) entering or leaving the household by food security group. As expected, production sufficient households (Group 1) produce significantly more cereal per consumption unit ($p<0.0001$) than production deficient households which are either consumption secure (Group 2) or insecure (Group 3). Conversely, mean cereal purchases among production deficient households (Groups 2 and 3) are significantly higher than Group 1 ($p<0.05$), although Scheffe's procedure fails to identify significant pairwise differences. Significant group differences are also evident in the amount of cereal received as salaries ($p<0.05$), with higher mean values recorded in the food insecure (Group 3). Large coefficients of variation within each group most likely account for the lack of significance among other variables.

When seasonal variation in allocative behaviour is taken into account, only a few trends are apparent which distinguish food insecure households. Repeated measures analysis of variance reveals significant seasonal variations in cereal stock inflows such as millet salaries ($f=40.24$ $p<0.001$) and domestic production ($f=40.30$ $p<0.001$). Univariate f-tests attribute most of this significance to greater cereal inflows in the harvest and dry seasons when most of these transactions take place. Significant group effects on seasonal variation in cereal inflows is confined to domestic cereal production ($f=5.45$ $p<0.01$).

ii) cereal outflows

As Figure 6.8 illustrates, annual cereal outflows are mainly due to household consumption (74%), with smaller outflows in the form of cereal sales (8%), gifts (6%), and alms (7%). Using one-way analysis of variance, significant group differences are found in the amount of cereal disbursed as salaries ($p<0.01$), gifts ($p<0.01$) and alms ($p<0.05$). In all three cases, Scheffe's procedure attributes this significance to higher mean values in production sufficient households (Group 1), compared to production deficient households (Groups 2 and 3) (Table 6.10 in Appendix VI).

Repeated measures analysis of variance reveals significant seasonal trends in cereal outflows which include salaries disbursed ($f=16.70$ $p<0.0001$), debt repayment ($f=5.77$ $p<0.01$), gift ($f=8.70$ $p<0.01$) and alms giving ($f=28.34$ $p<0.0001$). Univariate f-tests attribute most of this significance to the concentration of cereal outflows in harvest and dry seasons. Except in the case of salaries disbursed ($f=4.87$ $p<0.01$), no significant group differences are detected which help explain seasonal variation in outflow variables. Hence, in terms of the seasonal partition of millet outflows, there are few allocative behaviours which distinguish food insecure households in particular.

iii) household expenditure

Just as the household chooses to allocate cereal resources to different ends depending on the level of cereal stocks it possesses and the preferences and obligations of its members, among other considerations, the household must also decide how to partition scarce monetary resources among many competing categories of expenditure. Figure 6.9 summarizes annual patterns of expenditure for the village as a whole. Luxury goods (20%), condiments (19%), domestic purchases (15%), and debt repayment (12%) account for the bulk of these transactions.

Table 6.11 (Appendix VI) presents annual per capita expenditure by household food security group. No significant group differences in mean annual expenditure per capita are noted when aggregated or broken down by category. Once again, very large coefficients of variation within food security groups (~60%) probably account for this lack of significance. Notable trends include higher gift, agricultural, education and health expenditures and lower cereal expenditures among production sufficient households (Group 1); high mean cereal and condiment purchases among consumption secure households (Group 2); and greater luxury purchases and debt repayment among food insecure households (Group 3).

While a large number of expenditures have a significant seasonal character (government taxes $f=7.68$ $p<0.01$, debt repayment $f=17.55$ $p<0.0001$, luxury $f=3.47$ $p<0.05$, domestic $f=9.34$

$p<0.001$ and condiment purchases $f=4.09$ $p<0.05$), repeated measures analysis of variance fails to detect a significant group effect.

iv) an allocative profile of household food insecurity

The preceding analysis has indicated a number of behavioral trends associated with differing degrees of seasonal food insecurity. Among production sufficient households (Group 1), the most distinct behavioural trait exhibited is the greater quantity of cereal they produce per consumption unit and their lesser reliance on market purchases to supply household consumption needs compared to production deficient households (Groups 2 and 3). In contrast, production deficient households tend to be characterized by a greater dependence on cereal salaries, credits, gifts and alms, although there is evidence of great variation between households. In the blind households #220 and #230, household food stocks are supplied exclusively through gifts and alms received from others.

As concerns the allocation of these cereal supplies, after consumption, the production sufficient (Group 1) give allocative priority to investment in agriculture through the employment of millet wage labour (7% of outflows) and social networks through cereal gifts and alms (21% of cereal outflows). Only 6% of cereal outflows take the form of sales. These are largely accounted for by households #201 and #224 which regularly produce a marketable surplus. The majority of production sufficient households, however, do not sell, but rather direct outflows to social (gifts and alms) and productive investments (salaries). These allocative patterns are also reflected in monetary expenditures which suggest that production sufficient households give priority to productive and social investment.

In comparison, Group 2 tends to give allocative priority to sales (11% of cereal outflows) as opposed to investment in millet wage labour (2%) or social networks (8%). Many of these households are recently settled in the village, attracted by the non-agricultural opportunities provided by the weekly village market, and rely on cereal purchases made with income earned through other productive activities to supplement agricultural production. Millet debts are contracted with the confidence that they can be repaid later, although this may not be feasible in the case of successive drought years.

The consumption insecure (Group 3) have little to allocate and are characterized by consuming most of what they produce (83%). Relative to the Groups 1 and 2, they sell very little (5%), hire very little millet wage labour (2%) and participate little in social networks (alms and gifts, 8%).

6.4 Adverse Outcomes of Household Nutritional Risk

Analysis has underlined the differential onset, prevalence, severity and duration of seasonal food insecurity from one year to the next. In an environment prone to stochastic variation in rainfall patterns and other exogenous factors, extreme variability in cropping fortunes and food security is experienced by the majority of agricultural households. At either extreme, however, less variability is apparent. Structurally distinct in terms of their wealth, productive size and strength, wealth, and kinship affiliations, households which constitute the production sufficient group are predisposed to being food secure in both good years and bad. At the other extreme are severely consumption insecure households which tend to be chronically vulnerable irrespective of the vagaries of climate. Structurally disadvantaged in terms of their labour capacity, lifecycle stage and social and economic isolation, domestic production is rarely sufficient nor are assets available to invest in agricultural equipment, wage labour or the purchase of food stocks. The direction of causality between chronic poverty, food insecurity and endogenous constraints in this vulnerable group is impossible to surmise, each exacerbating the other such that the vulnerable household is caught in a productive and reproductive ratchet from which it may not easily escape (Chambers 1989).

The adverse consequences of seasonal food insecurity are best explained by Bamana agriculturalists themselves. In 25% of responses, the threat of food insecurity to the health and nutrition of household members is described. Adverse effects on productivity due to the impact of poor health on agricultural effort (12%), and time away from the domestic field in search for food (12%) are also cited. Finally is the devastating impact of severe or successive years of food insecurity on the viability of the household. In 21% of replies, food security was seen to provoke household tensions, sometimes to the point of the disintegration of the family unit (9%).

CHAPTER VII: HOUSEHOLD FOOD SECURITY STRATEGIES

7.0 Introduction

Chapter VI documented widespread seasonal food insecurity in the Bèlèdugu. Analysis established the dynamic character of this insecurity both in terms of interannual and interregional variations in the onset, severity, and duration of food shortage, and the number of households affected. Most notably, it revealed a significant association between the severity of seasonal food insecurity and household demographic, social and economic characteristics. The following chapter pursues this theme by investigating the relationship between these characteristics and the strategies households employ to overcome seasonal food insecurity.

The growing literature on the food security strategies of rural agriculturalists is comprised of a patchwork of empirical data based on anthropological (Fleuret 1986, Richards 1986, de Garine and Koppert 1988), nutritional (Campbell and Trechter 1982), and socio-economic research (Jodha 1975, Watts 1983, DeWaal 1989, Cutler 1984, 1986). In addition to this heterogeneity of disciplinary perspectives, the socio-cultural and environmental diversity inherent in the empirical literature complicate attempts to identify common patterns of food security behaviour. Theoretical generalization is further confounded by the fact that some of these studies describe the strategies of agriculturalists during periods of seasonal insecurity, while others focus on behaviour during drought or famine-scale shortage.

Nevertheless, attempts have been made to model food security strategies; a recurrent theme being the notion that rural agriculturalists respond to food insecurity in a more or less predictable sequence (Jodha 1975, Watts 1983, Cutler 1986, Corbett 1988). Motivating the development of sequential models is their potential application as convenient indicators of the severity of food crises to inform the policy decisions of donors and governments. Jodha (1975) provides one of the first attempts to sequence strategies in order of increasing distress. According to Jodha (1975), the 'adjustment process' begins with the restructuring of farming activities. As scarcity becomes more acute, current consumption and other commitments are curtailed, followed by the sale of inventories, and the sale and mortgage of assets. The final phase of the 'adjustment process' consists of out-migration (Jodha 1975:1613).

Watts (1983) further develops the theme of sequencing in his study of drought affected Hausaland. He argues that households do not respond arbitrarily to a food crisis, but serially, with respect to the intensity of the food crisis (Watts 1983:436). In his view, the food security behaviour of rural agriculturalists is graduated according to time, reversibility and the proportion of domestic resources they commit. Hence, at the lower end of the continuum are pliant responses such as the consumption of famine foods and borrowing food from kin. To the extent that these coping strategies are incapable of securing household reproduction, deeper responses are necessitated such as asset sale, indebtedness and land pledging, all of which are increasingly irreversible (Watts 1983:437).

Cutler (1986), Dessalegn (1988) and Corbett (1988) view food security strategies in terms of discrete stages whereby a household exhausts one group of strategies before moving onto the next group or stage. Based on observations of famine affected households in Red Sea Province, Sudan, Cutler (1986) conceptualizes 'pre-famine' behaviour in terms of three distinct and consecutive stages. Adaptive strategies are first undertaken which consist of remunerative activities such as the sale of small livestock, labour migration, and self employment. Following their exhaustion, the sale of key productive assets such as agricultural implements, large livestock, and household goods is necessitated. The third and final response is mass migration to towns and roadsides in search of charity.

In contrast to the predominantly economic focus of Cutler, Dessalegn (1988) takes into account both dietary and social strategies in his sequential model. Based on a study of the 1984 famine in Wollo, Ethiopia, he identifies four sequential stages of activities: 1) austerity and reduced consumption; 2) temporary migration; 3) divestment and asset disposal; and 4) crisis migration (Dessalegn 1988:22).

Reviewing evidence from four case studies, Corbett (1988) argues that households respond to food crises by the selective and sequential disposal of assets based on the criteria of resource commitment, adaptive flexibility and reversibility. Initial responses anticipate shortage by the acquisition of wild foods and livestock, the building of food stocks and investment in reciprocal relations. After these insurance mechanisms are exhausted, "Stage Two" responses are invoked which involve the disposal of key productive assets in order to purchase food; actions which will jeopardize the future economic welfare of the household. "Stage Three" marks the destitution of the household (Corbett 1988:1106-08).

Needed to substantiate this notion of sequence are rigorous, quantitative data which document the relative importance of food security strategies to household consumption as existing empirical data tend to be descriptive in nature, largely relying on retrospective methods of data collection (Campbell and Trechter 1982, DeWaal 1989, Cutler 1986). The tendency to confine analysis to the descriptive presentation of aggregate numbers of households adopting particular strategies also limits the existing literature (Jodha 1975, Fleuret 1986). Sensitivity to variations in food security behaviour among differentiated households is essential to the task of identifying those at greatest risk.

In response to these deficiencies in the literature, analysis in this chapter will be inter-disciplinary in approach, addressing the cultural, nutritional and socio-economic aspects of food security strategies in the Bèlèdugu, and presenting quantitative data disaggregated by household food security status. A micro-study in both scope and focus, its specific findings may be applied to similar dryland agricultural settings in West Africa; however, its broader theoretical concepts are of pertinence to the literature as a whole. Although this chapter specifically concerns the food security strategies of rural agriculturalists responding to transient or 'seasonal' food shortage, in adopting an approach sensitive to the changing severity of food insecurity, exigencies of drought and famine scale shortage may be accommodated.

It is hypothesized that the endogenous demographic, social and economic characteristics of households, in combination with exogenous factors such as climatic variation, geographic situation and market forces, define the degree of control a household has over its diverse resources and the flexibility it has in choosing and allocating among food security options (Thomas and Leatherman 1990). Indeed, by delimiting household access to food security strategies, these endogenous and exogenous factors determine a household's success in overcoming seasonal production deficits, and ultimately the degree of food security the household experiences. This hypothesis is elucidated by: 1) identifying food security strategies in the Bèlèdugu; 2) investigating their relative contribution to household consumption in two consecutive food shortage seasons which differ in their severity; and 3) considering their accessibility to food insecure households.

Section 7.0 outlines an approach to the study of food security strategies and identifies categories of strategies relevant to the present study. Using data from two consecutive soudure seasons, Section 7.1 describes six categories of coping strategies in terms of their cultural context and material content. It then evaluates the relative contribution of different strategies to household consumption by comparing the quantities of cereal procured from each source.

Section 7.2 breaks down the Bèlèdugu sample by village to explore how variations in environmental, geographical, and cultural milieu affect the array of food security strategies available to agricultural households. The temporal character of seasonal food security strategies is also considered by examining them in the context of the agricultural calendar. Section 7.3 uses empirical data from 1988 and 1989 to consider the accessibility of food security strategies to vulnerable or food insecure households. Finally, Section 7.4 examines the timing and order of food security strategies to assess the validity of sequential models found in the literature, and proposes an alternative approach to their assessment.

As in the previous chapter, the main unit of analysis is the household with the recognition that many of the so-called "collective" strategies households undertake to secure food are in fact the outcome of the power struggles between the divergent interests of individuals, genders, and generations within the domestic unit. Using specific examples, however, an attempt is made to reveal the manner in which individual and collective interests conflict and coalesce within the corporate household. Although analysis is mainly confined to descriptive statistics, one-way analysis of variance and simple correlation statistics are used to compare the coping strategies of households disaggregated by food security group in Section 7.3.

7.1 An Approach to Food Security Strategies

Obscuring the literature on coping strategies is the proliferation of loosely defined terms it employs (Devereux 1991). The expressions 'coping strategies', 'coping mechanisms', 'adaptive responses', 'survival strategies', 'behavioral responses' (Campbell and Trechter 1982), 'drought-response mechanisms' (Fleuret 1986), and 'adjustment devices' (Jodha 1975) are used interchangeably to describe the phenomenon of short-term adjustments to food deficits experienced by semi-subsistence agriculturalists. As emphasized by Devereux (1991), a more rigorous terminology is required.

To clarify discussion in this chapter, a taxonomy is proposed which corresponds to the nature or 'purpose' of strategies given the severity of shortage to which the rural agriculturalist is responding[1]. As Table 7.0 outlines, the term 'accumulation' describes the aggrandizing strategies of households facing no threat of food insecurity; 'insurance' strategies such as cereal stock-piling are risk-reducing responses to mild and predictable periods of food insecurity; 'coping' strategies represent immediate responses to moderate, often drought, pest or poverty-induced food shortage; and 'survival' strategies are desperate measures undertaken in the context of severe and/or extended famine conditions.

Table 7.0 Terminology Relating to Food Security Strategies[1]

degree of food insecurity	reasons for food insecurity	term/purpose
none	none	accumulation
mild	cyclical shortage	insurance
moderate	severe drought/blight	coping
severe	famine	survival

[1] The expression 'food security strategies' refers to all strategies irrespective of their purpose.

The absence of a consistent approach to the categorization of strategies is another consequence of the micro-level nature of the literature. Longhurst (1986) groups food strategies according to the severity of food crises to which the household responds. He identifies four sets of

[1]This taxonomy reflects Campbell and Trechter's (1982) three-stage continuum of food deficits which correspond to an increasing severity of shortage: 1) soudure or seasonal shortage; 2) food consumption shortage caused by economic constraints not the physical unavailability of food, and; 3) catastrophic famine, characterized by a physical shortage of food requiring national and/or international intervention.

strategies used by rural producers to offset seasonal food shortages: choice of cropping pattern; drawing on assets and stores; developing and exploiting social relationships, and; diversifying off-farm income opportunities. These activities are intensified as food shortage escalates into famine, and the household resorts to famine food gathering, migration and the sale of farmland and assets (Longhurst 1986).

Corbett (1988) differentiates between 'precautionary' or 'insurance' strategies that are developed in response to repeated exposure to the same non-acute risk, and 'crisis' strategies which are developed to cope with unusually severe or unexpected threats to food security. Devereux (1991) argues that strategies should be classified according to the primary objectives of the household; whether they be nutritional, social or economic.

The task of categorization is further complicated by the fact that some strategies are pursued as normal activities in conditions of food security. For example, depending on the food security status of the household, livestock sales may represent: 1) a normal means of trading and accumulation; 2) a normal response to seasonal food deficit, the herd being constituted for this purpose; or 3) distress sales which represent an irrevocable economic loss to the household necessitated by severe food crisis. Indeed, only by soliciting the perceptions of the household can a particular strategy be interpreted as a normal response or an abnormal symptom of food insecurity and loss of domestic control. For this reason, when identifying categories of strategies it is important to recognize the continuum of increasing stress within each strategy (Devereux 1991). Moreover, given this continuum, it is essential to understand the perceived consequences attached to each strategy before attempting to classify them by category.

Integrating micro-level observations in the Bèlèdugu with the comprehensive reviews of Fleuret (1986), Longhurst (1986) and Corbett (1988), six broad categories of strategies are identified which are appropriate to the particular study environment yet sufficiently general to facilitate comparative analysis:

1) **cropping techniques** (staggered planting, early-ripening varieties, premature harvest, intercropping, field dispersion, shifting cultivation, animal fertilizers, cultivation of large areas);

2) **labour sale** (dry and wet season wage-labour within and beyond the village);

3) **remunerative activities** (income-generating crafts, sale of wild goods, garden and agricultural produce and prepared foods);

4) **asset sale** (sale of small and large/productive livestock, agricultural equipment, valuables);

5) **claims and transfers** (gifts from village and non-village neighbours and kin, migrants, external food aid, credit with and without interest from market traders, neighbours and kin); and

6) **dietary change** (alterations in meal pattern, frequency and composition).

Table 7.1 illustrates a hypothetical continuum within each of these strategies as they intensify in response to an increase in the severity of food shortage.

Table 7.1 Intensification of Food Security Strategies with Increasing Food Shortage

	food shortage:		
strategy	mild	moderate	severe
cropping techniques	early-ripening varieties	premature harvest	abandon fields
labour sale	at slow periods	at peak periods	migration
remunerative acts	crafts	skilled labour	migration
asset sale	surplus livestock	small livestock	large livestock
claims and transfers			
-gifts	nearby kin	distant kin	begging
-credit	no interest	small interest	high interest
dietary change	rationing	wild fds w/cereal	wild fds alone

7.2 Food Security Strategies in the Bèlèdugu

This section examines the socio-cultural and environmental context of the six categories of food security strategies identified above and their material contribution to household consumption. Analysis is based on cross-sectional data from the Bèlèdugu collected during two consecutive shortage seasons of contrasting severity.

a) Cropping Techniques

Given the considerable annual and spatial variation in the amount and distribution of rainfall characteristic of the Bèlèdugu and most of West Africa, Bamana agriculturalists employ a diversity of risk-reducing cropping techniques to minimize crop loss in the event of drought, flooding, or pest invasion. To simplify this diversity, seven indigenous strategies are identified which function as insurance mechanisms against crop failure:

i) staggered planting

Staggered planting is a cropping technique whereby crop varieties with different maturing times are planted at different points in the cropping season. This practice spreads the risk of late or insufficient rainfall for germination, and smooths out labour bottlenecks during the weeding period.

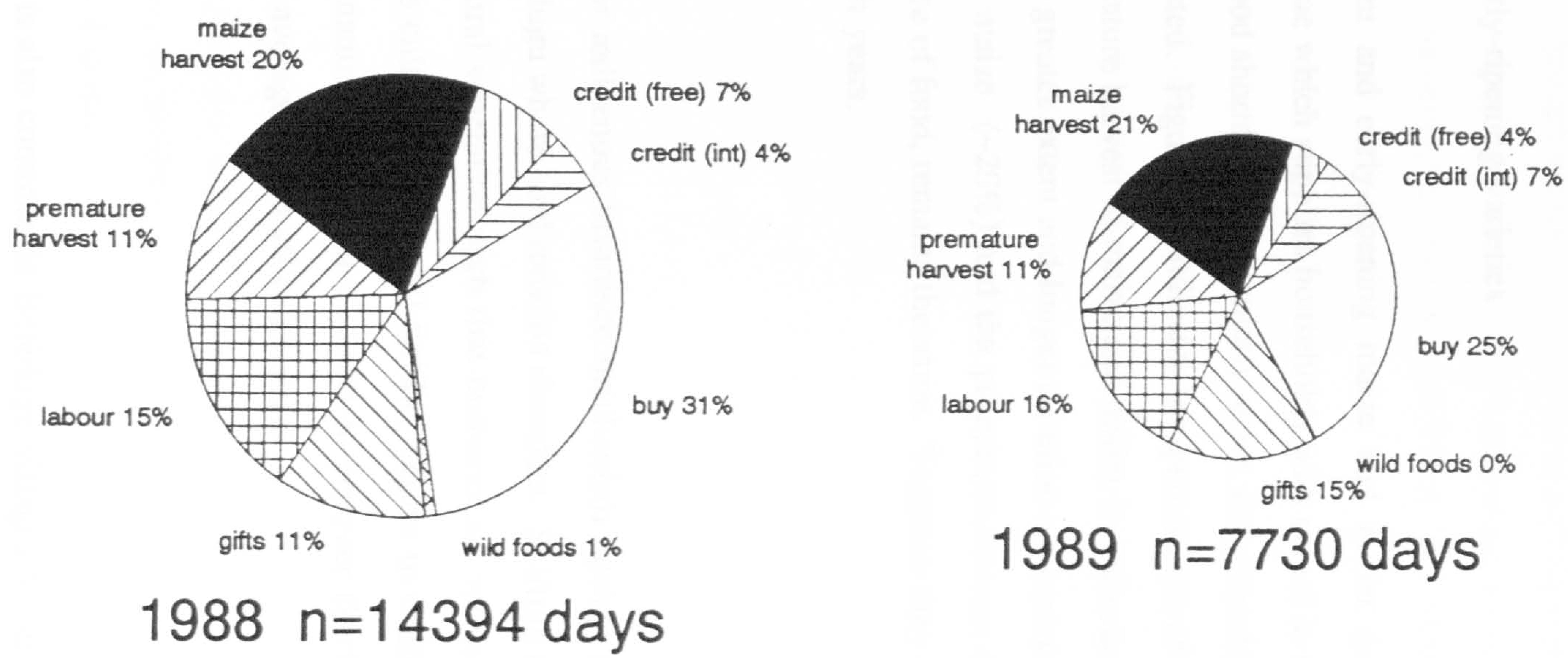
ii) intercropping

Intercropping involves the mixing or inter-planting of different crops or crop varieties such as pulses and cereals. This practice works to inhibit the spread of crop-specific pests and diseases, staggers demands for water and nutrients, and helps contain weed infestation (Norman 1977). The intercropping of cereals with nitrogen-fixing legumes, such as cowpea and groundnut varieties, has the further beneficial effect of making nitrates available to subsequent crops. Similar effects are achieved by rotating groundnut and cereal crops from one year to the next (Richards 1985:69-70).

iii) spatial dispersion of fields

The topographical and spacial dispersion of fields is another risk-reducing mechanism used to counter the variable rainfall patterns of the Bèlèdugu. The exploitation of variations in soil properties through the cultivation of crop types which suit its particular composition is one such technique. Finger millet, for example, flourishes better on sandy loams compared to sorghum which prefers more silty soils.

Figure 7.0 Percentage of Food Shortage Days Supplied by Different Food Sources in 1988 and 1989



7 villages, Beledugu, Mali

The judicious exploitation of lowland and upland fields is another technique which protects agriculturalists from too much or too little rainfall. During the severe soudure of 1988, seven Bèlèdugu households attribute their food security to the cultivation of lowland fields less vulnerable to lack of rainfall. An ironic twist to this practice is the plight of three households in 1989 whose production is destroyed by flooding by virtue of their lowland placement.

iv) drought resistant and early-ripening varieties

The use of drought resistant and early-ripening maize and millet (*suna*) varieties is a widespread cropping technique which supplies households with cereal in the latter part of the agricultural season. When food shortage is particularly acute, the premature harvest of maize and millet is often necessitated. Figure 7.0 indicates the percentage of food shortage days in which maize and the premature harvest of maize and millet function as the primary source of food in 1989. Despite the greater extent and longer duration of food shortage in 1988, the percentage of days in which maize (~20%) and the premature harvest of maize and millet (11%) provide the main source of food, remains the same. Together they furnish almost one-third of shortage days in both years.

v) shifting cultivation

Shifting cultivation is another indigenous insurance mechanism against crop failure widely practised in areas of the Bèlèdugu where land remains abundant. Shifting cultivation involves clearing and burning the natural vegetation such that nutrients are released, and weeds and pests eliminated. The area is cultivated until soil fertility begins to decline, whereupon the field is left fallow and the natural vegetation allowed to recover (Richards 1985:49-50). Fallow time in the Bèlèdugu averages from 10 to 15 years.

vi) animal fertilizers

The use of animal fertilizers is also common in Bèlèdugu villages located on the migratory paths of Fulbe and Moor herders. Arranged in concentric circles about the village, fields closest to the village are well-manured by the ruminants of Moor visitors who lodge on the lands of host families for much of the dry season. A second ring of land is devoted to the extensive cultivation of millet and groundnut crops. In exchange for animal manure, Fulbe herders are permitted to graze their cattle on the millet stalks remaining after the harvest.

vii) cultivation of larger areas

The cultivation of larger areas through the use of hired labour and agricultural equipment such as oxen drawn ploughs and seeders provides an important means of extending crop yields. Production remains limited, however, by weeding which is less easily accomplished by draught-power.

A growing body of literature recognizes the ingenuity and adaptive flexibility of cropping techniques among dryland agriculturalists in West Africa (Chambers 1983, Richards 1985, Watts 1987). Indeed, in an effort to assure household subsistence, Bamana farmers must continually adjust cropping techniques to perturbations in soil fertility and rainfall, in addition to other unpredictable occurrences such as the death of a draught animal, insect invasion or the illness of a key productive worker.

b) Labour Sale

Seasonal labour sale, common in the Bèlèdugu and the rest of West Africa, is a food security strategy of vital importance to dryland agricultural households. Its character is cyclical, changing in type and location with the seasons[2]. Harvest season labour sales are largely undertaken in the nearby region. While male threshing and harvesting activities are non-monetary involving reciprocal exchange between participating households, women are hired to winnow the harvested crops and remunerated in cereal. Dry season labour sales, on the other hand, often involve migration to regional centres where manual and domestic work is available. Rainy season labour is generally confined to agricultural work in the vicinity of the village during cultivation and weeding periods.

---

[2]Longer-term wage-labour migration is considered under the category of claims and transfers given the unpredictable nature of remittances made by absent migrants who do not regularly participate in household production or reproduction.

In good years, the balance of harvest and dry season labour earnings accrue to the individual as opposed to the household collective. In other words, although a certain portion of labour earnings may be remitted by way of gifts to household members, these strategies are largely undertaken for private accumulation. One such example is the migration of young girls to Bamako as domestics for the purpose of earning funds to purchase household utensils in preparation for marriage. In a similar fashion, young men undertake seasonal labour to accumulate brideprice or purchase luxury goods. When the prospect of food deficit is clear, individual earnings may be called upon by the household head for the collective purchase of cereals as insurance against shortage.

In a like manner, labour sales during the agricultural period may be undertaken as accumulation strategies by individuals in food secure households with time or labour to spare. Having completed the cultivation of their household fields prior to the onset of the rains, food secure household #228 proceeded to hire their team of oxen and plough to households able to pay.

However, in the context of food insecurity, labour sales become an important means of coping with shortage or impending shortage. Labour is released from domestic production to work in the fields of farmers in the same or neighbouring villages. In addition to a money or cereal salary, meals are generally provided to hired workers, further relieving pressures on constrained domestic food supplies. Female labour sales in the form of domestic work in payment for cereal or bran are also undertaken in the context of increasing food insecurity. In the village of Falakan this is particularly common given its close proximity to the regional centre of Kolokani where there is a demand for domestic help.

Table 7.2 illustrates the greater percentage of Bèlèdugu households resorting to weeding and domestic labour sales in 1988 which is indicative of the severity food shortage compared to 1989. General labour, which mainly occurs on either side of the peak agricultural season (11% of hholds), does not vary nor do labour sales undertaken during the clearing and cultivating period (6% of households).

Table 7.2 Households Engaging in Labour Sales During Soudure Seasons in 1988 and 1989: n=148 households, Bèlèdugu, Mali

labour type	1988 % hholds	1989 % hholds
general labour	11	11
clearing/cultivating	6	6
weeding	29	19
domestic	8	2

While the majority of labour sales take place in the village (1988=39%; 1989=40%), a large percentage occur in nearby centres where wage-labour is required (1988=37%; 1989=34%). During the more severe soudure of 1988, wage-labour in nearby villages takes on a greater significance (16%) than in 1989 (8%). In 1988, payment is most frequently in the form of money (58%), followed by cereal (32%) and bran (10%). Payment in bran occurs in only 4% of labour sales in 1989, the most frequent mode of remuneration being money (69%) and cereal (26%). In the case of a money salary, cereal is generally purchased such that in 1988 cereal purchases are used for immediate consumption in 93% of cases, compared to 79% in 1989 when proceeds also serve to reinforce stocks (15%).

Perceived consequences of labour sales in 1988 mainly concern reduced time devoted to domestic agriculture (65%), with a further 18% noting an actual decline in production. Only 13% of households state that no consequences are experienced. This contrasts with 1989, in which 59% of labour sales are considered to have a negative impact on agricultural time, and a further 14% are thought to contribute to a decline in crop production. No consequences were associated with 27% of labour sales.

Referring back to the continuum character of food security strategies expressed in Table 7.1, data comparing 1988 and 1989 indicate that labour sales intensify with increasing severity of shortage. In addition to the greater frequency of labour sales in 1988, less preferable wage-labour is undertaken. The necessity for food is so acute in some households that women are forced sell their labour for payment in cereal bran used for household consumption. Similarly, the large percentage of households selling labour during the weeding period is a symptom of increasing food stress given the negative consequences associated with the outflow of household labour during this critical period of production.

c) Remunerative Activities

Despite the fact that household members in the Bèlèdugu enjoy a more or less equal access to basic subsistence needs, this coexists with individual ownership of assets and income sources. Hence, while the produce of the communal field belongs to the household collective, crops and income earned by individuals cultivating private plots or engaging in private income-generating activities belong to the individual. In the event of household food insecurity, individuals are often required to draw upon private resources in the effort to assure household food consumption.

A sharp gender distinction is evident in most remunerative activities in keeping with the social and economic separation between the sexes characteristic of Bamana society (Turrittin 1988, Rondeau 1987). In general, female activities relate to selling products of the land, while male activities concern buying for resale (cola nut, sugar and batteries), negotiating commercial transactions with strangers, transportation, and the skilled occupations of weaver, blacksmith, fetisheur, butcher and tailor (Turrittin 1988).

Table 7.3 provides an example of the gender and seasonal specificity of remunerative activities in the village of Sèbèkoro. Male remunerative activities largely comprise the sale of agricultural produce in the harvest season, and the sale of livestock and crafts in the dry season. Involvement in remunerative activities decreases two-fold in the rainy season when time constraints limit non-farm production.

Among women, the most common remunerative activities concern the sale of prepared foods, wild goods, and garden produce. While the majority of okra, *da*, cowpea and groundnuts cultivated and harvested by women are used in domestic cuisine, small quantities are exchanged informally or sold at the local market. Liberated from household responsibilities, older women may cultivate small plots of millet in addition to pulses and garden produce. The sale at the local market of groundnut butter and millet couscous and cakes prepared from winnowing earnings are also important in the harvest season[3]. Dry season remunerative activities also centre on the sale of prepared foods. This activity diminishes somewhat in the rainy season, and the gathering and labour intensive processing of wild foods, such as the transformation of nere and shea-nut fruit into soumbala and shea-nut butter for sale, increases in frequency.

Table 7.3 Seasonal Remunerative Activities of Men and Women in Sèbèkoro 1988-89[1]

activity	% male harvest n=54	% male dry n=46	% male rainy n=54	% female harvest n=86	% female dry n=89	% female rainy n=97
none	20	28	63	28	33	35
crafts/skills	20	26	11	3	4	3
wild goods	5	7	--	15	15	39
garden/agri produce	42	15	--	12	3	4
market goods	4	7	4	2	6	3
prepared fods	2	2	2	38	39	16
livestock	7	15	2	1	--	--

[1]Because 1988-89 represents a mild soudure season, there is no necessity for men to divert their labour away from agriculture and towards the pursuit of food. The comparatively greater intensity of female remunerative activities is mainly due to the abundance of shea-nuts in this particular year, and hence, their widespread collection, extraction and sale.

The proceeds from female remunerative activities are mainly allocated to the exchange or purchase of sauce ingredients for which women are responsible. Any excess income is oriented towards their needs or those of their children (Fulton and Toulmin 1982, Lewis 1979:299-313). Men, on the other hand, are primarily responsible for the provision of cereal. Hence, in the event of a meagre harvest, male remunerative activities intensify in an effort to reinforce cereal stocks in preparation for the agricultural season. The sale of dry season crafts (mats, rope, and baskets) is initiated as the granary empties. The depletion of existing stocks of crafts necessitates the investment of both time and capital in their creation which has obvious repercussions for domestic agricultural production. The proceeds from female

[3]A common yet 'illicit' practice among women processing and preparing the daily millet ration is the removal of a small amount quantity for personal use.

remunerative activities are generally diverted to cereal provision only when male sources have been exhausted.

The greater percentage of households engaging in remunerative activities during the soudure season in 1988 is symptomatic of its relative severity compared to 1989 (Table 7.4). In 1988, sales of crafts (10%), garden produce (7%) and market goods (4%) represent the most widespread household remunerative strategies used to purchase cereals for immediate (74%), future (19%) and private (7%) consumption. In 1989, only 5% of households engage in the sale of crafts (5%), while 3% sell skills, garden produce and market goods in order to purchase cereals for immediate (65%), future (24%) and private (11%) consumption.

Table 7.4 Households Engaging in Remunerative Activities During Soudure Seasons in 1988 and 1989: n=148 households, Bèlèdugu, Mali

activity	1988 % hholds	1989 % hholds
crafts	10	5
skills (fetish)	3	3
wild food sale	3	2
grass/wood sale	2	2
garden produce	7	3
market goods	4	3

In terms of the perceived consequences of these activities, in both years, 35% of cited remunerative activities are considered vital to food security. Given more severe soudure conditions in 1988, negative consequences are associated with 37% of remunerative activities undertaken in that year: 26% relate to a perceived loss of assets, and 11% to a loss of agricultural time. In 1989, negative consequences mainly concern the loss of valuable assets (24% of cases).

In sum, remunerative activities in the Bèlèdugu serve a number of different purposes depending on the degree of resource constraint a household is experiencing. They provide individual incomes to household members in normal conditions, and, in the context of mild to moderate food insecurity, proceeds are diverted towards the purchase of cereal for collective consumption. The fierce individualism that accompanies famine-scale shortage may, however, result in the reversion of remunerative income back to the individual in the interests of survival (Dirks 1980, Laughlin and Brady 1978). While this behaviour was not observed during the study, reports of household fission due to the unwillingness of individuals to cooperate in communal subsistence efforts were common during drought periods in 1969-73 and 1984-85 (hhold #'s 227, 316, 402 and 416).

Results from the Bèlèdugu indicate that through remunerative activities men and women make separate yet complementary contributions to household provisioning (Jiggins 1986). In the event of a cereal shortfall, male remunerative income is generally mobilized first; female remunerative income being diverted to cereal procurement when male resources are exhausted. These findings contradict Campbell and Trechter's (1982) observation that men play a subordinate role to women in the provision of cereal during the soudure season in Northern Cameroon[4].

d) Asset Sale

In the Bèlèdugu, livestock holdings are synonymous with wealth (Lewis 1979, Fulton and Toulmin 1982). However, not only do livestock represent wealth and the capacity to invest, they also function as a source of security that may be drawn upon in times of need. The rearing of small livestock is quite common, the majority of households (59%) possessing at least one goat. Fewer households own larger and more prestigious animals. In the Bèlèdugu, 37% possess at least one cow or ox, 47% own one or more donkeys and 27% have one or more sheep.

During the soudure of 1988, asset sales are comprised of goats (71%), productive animals such as oxen, donkeys or horses (14%) and sheep (11%) (Table 7.5).

[4]Campbell and Trechter (1982) conclude that women are more directly concerned with the overcoming of food shortages on the basis of the greater 'variety' of responses they provide compared to men. However, no quantitative assessment of the amount of cereal procured is attempted.

Table 7.5 Frequency of Asset Sales During Soudure Seasons in 1988 and 1989: n=148 households, Bèlèdugu, Mali

	1988		1989	
asset	n	%	n	%
goats	148	71	76	77
sheep	23	11	12	12
cattle	5	3	3	3
ox/donkey/horse	29	14	7	7
belongings	3	1	1	1
	208	100	99	100

In 1989, the complexion of asset sales reflects the less severe nature of soudure conditions. As small livestock are more easily replaced or regenerated, their liquidation takes precedence over the sale of larger animals less easily replaced, and in the case of work animals of critical importance to agricultural production. Accordingly, goats comprise the large majority of asset sales (77%), while the sale of draught animals decreases to 7%. In both years, asset sales are rarely regarded as an insurance mechanism with which to reinforce household stocks. Rather, they function as coping strategies to satisfy an immediate need for food (96-98% of asset sales).

The perceived consequences of asset sales reflect the function of asset stores in the household. Some households consider assets a source of liquid wealth to be converted into food when shortage occurs. Hence their sale is not considered a loss, but a necessary and useful event. In the words of one farmer: "*Le bétail est la route de la nourriture; on doit l'utilizer pour survivre et non le contempler et mourrir de faim*". In 1988, 56% of asset sales were interpreted in this manner, while 44% of cases were viewed as a loss of valuable resources. In 1989, 70% of asset sales were considered necessary and useful, while 30% were regarded as a loss.

e) Claims and Transfers

The category claims and transfers includes the receipt of gifts and credit from sources outside the household whether the donor be kin, migrant, neighbour, market trader or non-governmental agency. While in the case of kin and neighbour reciprocities may be cultivated through marriage and gestures of good will, for the most part the household has minimal control over extra-household remittances. For example, although almost 40% of households have at least one person absent on long-term migration, regular remittances are received in only 4% of cases, and occasional remittances in 42% of cases. The distance of the migrant from the village makes it difficult to enforce the migrant's obligation to the household: only 19% of migrants are located in nearby regional centres while 11% are found in Bamako, 28% in another region, and 42% are abroad in France, the Ivory Coast or Libya. In a similar fashion, credit sources are unpredictable; the agriculturalist is unable to count on the ability of nearby kin to provide a cereal loan, or the willingness of a trader to provide credit for reasonable interest.

Chapter VIII will focus exclusively on claims and transfers given the complexity of social networks of exchange and their cursory treatment in the literature.

f) Dietary Change

Two main manifestations of dietary change are observed in the Bèlèdugu in response to impending or immediate food crises: the hunting/ gathering of wild food stuffs for household consumption and the rationing of normal household consumption. In fact these two strategies are frequently associated; reduced cereal rations often being supplemented by wild foods.

Certain forms of foraging such as the gathering of shea-nut (*Butyrospermum parkii*), locust bean (*Parkia biglobosa*), and wild leaves for sauces, and the hunting of guinea fowl and partridge are an integral part of normal seasonal diet among the Bamana. However, in the context of food shortage, the gathering of wild tubers (*Cyperus esculentus, Sphenostylis stenocarpa*), raphia fruit (*Borassus aegyptica*) and wild leaves to supplement insufficient cereal rations, or replace cereals entirely, are symptoms of food crisis[5]. The use of bush produce to replace or supplement cereal is considered unpalatable and culturally unacceptable in Bamana and other farming cultures (Messer 1989). Indeed, the quality of Bamana cuisine is judged by the quantity of cereal provided, and the flavour of accompanying sauces.

In this respect, the use of bush foods may be considered a last resort; a signal that all other resources have been exhausted, and the household is reduced to the lowest form of survival (de Garine and Koppert 1988:238). A further constraint to the use of wild foods is their increasing scarcity. Pressures on land resources such as deforestation due to land clearing for cultivation have contributed to the disappearance of many species. A loss of cultural knowledge regarding the edibility, whereabouts and processing of wild foods has also occurred given the preponderance of the market in bridging gaps in domestic production (Fleuret 1986).

Following the feasts and festivities which mark the harvest season in the Bèlèdugu, a period of food conservation ensues mainly due to the greatly reduced energy needs of household members in the dry season (see Chapter V). Indeed, common to many agricultural societies, the dynamics of feasting and rationing and activity and rest are normally experienced in the Bèlèdugu (Mauss 1950). The dry season out-migration of men to regional centres and married women to their natal villages also serves to conserve granary stores in anticipation of the agricultural season when adequate food supply is critical to agricultural production. When cereal stocks are judged insufficient to last the year, agriculturalists may choose to minimize 'current commitments' in the interests of future consumption: i.e.) postpone marriages, funerals, investments in agriculture and/or material goods (Watts 1983, Devereux 1991).

More drastic measures are taken when the household granary is almost empty and other means to procure food are not readily available. The reduction of the normal household ration is a usual first response to food shortage. This may involve normal preparations in smaller quantities, or the substitution of normal preparations with millet gruel (*seri*). As Table 7.6 indicates, rationing is a widespread response to cereal shortage during the soudure of 1988 undertaken by 51% of households compared to 23% in 1989. A less preferred dietary strategy

[5]On average, three-quarters of all edible wild plant products are supplied by trees and shrubs making them more resilient to variations in rainfall compared to annual herbaceous plants or grasses (Becker 1986).

is the supplementation of severely curtailed cereal rations with the addition of leaves to increase quantity, or the substitution of a main meal with dah (*Hibiscus sabdariffa*) and baobab leaves (*Adansonia digitata*), raphia fruit (*Borassus aegyptica*) or various wild tubers. In 1988, 15% of households report this practice compared to 5% in 1989.

The consumption of wild foods alone in the event of absolute cereal shortage is a coping strategy of last resort. The most common cereal substitutes are dah leaves, wild raphia and tubers which require labour intensive processing to make them edible. Negative health consequences are associated with the exclusive consumption of wild foods in one-quarter of reported cases. Diarrhoea, oedema and stomach ache are the most common symptoms, largely experienced by children. In 1988, 11% of households report the exclusive consumption of wild foods for at least one day. This decreases to 2% of households in 1989.

In the case of large households, another dietary strategy is the abandonment of communal eating arrangements for smaller eating units. In household #206, consumption patterns are rearranged during the soudure period in order to conserve communal grain stores. Whereas household members are fed using grain drawn from the communal granary when cultivating the household field (*foroba*), on days reserved for non-communal agriculture (2 days/wk), agnates are responsible for feeding their respective wives and children.

Table 7.6 Households Adopting Dietary Strategies During Soudure Seasons in 1988 and 1989:

n=148 hholds, Bèlèdugu, Mali

change	1988 % hholds	1989 % hholds
rationing	51	23
wild foods w/ cereal	15	5
wild foods alone	11	2

g) Relative Contribution of Food Security Strategies to Household Consumption

As shown in Table 7.7 the more widespread adoption of food security strategies during the 1988 soudure is evidence of its greater severity compared to 1989. In both years, the cultivation of maize is the most prevalent cropping strategy adopted by Bèlèdugu households. This is followed by rationing (51% of hholds), labour and asset sale (36% and 36% respectively), and premature harvest (29%) in 1988.

Table 7.7 Households Adopting Food Security Strategies During Soudure Seasons in 1988 and 1989:

n=148 households, Bèlèdugu, Mali

	strategy	1988 % hholds	1989 % hholds
1)	cropping techniques:		
	- maize	59	40
	- premature harvest	29	15
2)	labour sale	36	26
3)	remunerative activities	26	17
4)	asset sale	36	16
5)	claims/transfers:		
	- gifts	27	13
	- credit/free	9	13
	- credit/int	24	13
6)	dietary change:		
	- rationing	51	23
	- wild foods w/cereal	15	5
	- wild foods alone	11	2

In contrast, in 1989, labour sale (26% of hholds), rationing (23%), and credit with interest (24%) follow the maize harvest in order of household prevalence. The greater emphasis on the less preferable coping strategies of asset sales, dietary change and premature harvest are symptoms of the severity and duration of food shortage in 1988.

Table 7.8 compares strategies with respect to their mean contribution to household consumption. Asset sales (130 kg/hhold), labour sales (95 kg/hhold), and remunerative activities (80 kg/hhold) are the three most productive coping strategies in 1988. In 1989, labour sales are the most profitable cereal source (115 kg/hhold), followed by asset sales (65 kg/hhold) and remunerative activities (45 kg/hhold). As concerns claims and transfers, in 1988 gifts (75 kg/hhold) and credit without interest (70 kg/hhold) represent important sources of cereal. They diminish in importance in 1989 to 45 kg/hhold for gifts and 20 kg/hhold for credit without interest. The mean quantity of cereal supplied as credit with interest remains the same in both 1988 and 1989 (20 kg/hhold).

Once again, the severity of shortage is 1988 is reflected in the large amount of cereal procured by way of asset sales and remunerative activities. This difference is even more striking given the fact that cereal prices are three times higher in 1988 compared to 1989. Indeed, low cereal prices in 1989 explain why the quantity of cereal (kg/cu) procured through labour sales is slightly greater in 1989 when overall labour sales are less prevalent than 1988 (Table 7.7). Of particular interest in Chapter VIII is the greater importance of cereal gifts and interest-free credit to household subsistence in 1988 when shortage is more acute; a finding contrary to the widespread perception that reciprocity retracts with increasing scarcity.

Table 7.8 Millet (kg/hhold) Supplied by Food Security Strategies During Soudure Seasons in 1988 and 1989:

n=148 households, Bèlèdugu, Mali

	strategy	1988	(sd)	1989	(sd)
1)	cropping techniques	N/A	N/A	N/A	N/A
2)	labour sale	95	(220)	115	(310)
3)	remunerative activities	80	(230)	45	(140)
4)	asset sale	130	(250)	65	(185)
5)	claims/transfers:				
	- gifts	75	(180)	35	(135)
	- credit/free	70	(240)	20	(85)
	- credit/int	20	(85)	20	(55)
6)	dietary change	N/A	N/A	N/A	N/A

7.3 Food Security Strategies According to Place and Time

Just as the seven sample villages have variable success in producing sufficient cereal to satisfy annual consumption needs (Chapter VI), they are also unique in the types of strategies used to overcome production deficits. Intervillage and interannual differences in the amount of cereal procured from different strategies suggest that the particular geographic and cultural complexion of a village bears on the array of coping strategies at a household's disposal.

Table 7.9 demonstrates marked intervillage variation in the amount of cereal procured from different coping strategies[6].

Table 7.9 Intervillage Comparison of Cereal (kg/cu) Supplied by Different Strategies in 1988 and 1989:

			7 villages, Bèlèdugu, Mali							
strategy		mean	Kossumale	Seberoko	Falakan	Dubala	Bala	Fonfilebugu	Zambugu	I
labour sale	1988	13	4	10	38	30	9	6	3	*
	1989	17	3	17	57	29	6	13	4	***
remun acts	1988	12	3	13	4	20	10	30	7	N/S
	1989	8	2	13	9	5	6	7	13	N/S
asset sale	1988	16	20	13	8	36	8	19	8	N/S
	1989	8	3	.5	27	14	2	17	2	**
gifts	1988	9	6	19	8	4	16	6	1	*
	1989	7	1	9	0	3	8	10	0	N/S
credit/free	1988	7	6	3	4	6	.5	1	30	***
	1989	3	3	3	3	4	3	3	2	N/S
credit/int	1988	2	2	3	4	0	0	2	3	N/S
	1989	3	0	7	5	0	0	2	1	***

I oneway analysis of variance: * $p<0.05$ ** $p<0.01$ *** $p<0.001$ N/S not significant

In 1988, food insecure households in Kossumale and Dubala get most of their cereal from asset sales, the proceeds from which are used to pay for cereal at nearby local markets. In contrast, gifts constitute the most important source of cereal in the villages of Bala and

[6] Mean quantities of millet are expressed per consumption unit to control for household size which differs markedly from village to village.

Sèbèkoro. In the case of Bala, the receipt of NGO food aid and the operation of strong networks of social exchange explain the predominance of cereal gifts in bridging the food shortage period. Bala's close proximity to the centre of Didieni expedites the distribution of food aid and the marketing of remunerative activities. In Sèbèkoro, strong kinship ties with neighbouring villages in the *Kakolola*, and the contribution of remittances from the many migrants in the village, explain the large proportion of cereal procured through gifts. The presence of a weekly market in the village also facilitates the sale of assets and remunerative activities.

As indicated in Table 7.9, both Falakan and Dubala rely heavily on labour sale to breach the soudure food gap. Falakan's close proximity to Kolokani facilitates the daily commute of women to perform domestic work for payment in cereal and bran. For this reason, many women in Falakan have abandoned agricultural production altogether in the daily pursuit of food. Men also engage in wage labour on the farms of commercial traders. In a similar fashion, men from Dubala have developed wage labour arrangements with wealthy households in surrounding villages, many of which are located in lowland areas and therefore are less vulnerable to rainfall variability.

Located reasonably close to weekly markets in Massantola and Kolokani, the villagers of Fonfilèbugu engage in traditional crafts during the dry season which are sold in order to purchase cereal. Zambugu's situation on two sites, one lowland and one upland, explains the importance of interest-free cereal credits in overcoming food shortage. Insulated against the vicissitudes of rainfall, households cultivating lowland fields are considerably more wealthy than households farming upland areas. As a result, cereal credits are frequently extended by these households to the food insecure farming upland areas.

When strategies are viewed in the context of the agricultural calendar, it appears that certain strategies are more common in particular agricultural periods (Table 7.10). Buying millet with liquid wealth or the proceeds of asset sales is spread over the agricultural calendar. Intensifying during the first and second weeding periods, purchases lapse when the harvest of maize and early-ripening millet commences. Rationing also peaks in the same period, however, the more severe forms of dietary change are delayed to the end of the agricultural season. Cereal and money credits, both with and without interest, are similarly avoided, given the Bamana farmer's aversion to repaying debts in subsistence cereal. Gifts are also more common in this final period. It may be that households delay the giving of assistance to kith and kin until such time as they are confident that remaining cereal stocks are sufficient to last the season.

Table 7.10 Frequency of Strategies over the Agricultural Calendar: 148 households, 7 villages, Bèlèdugu, Mali

	strategy	preagri	clear/cult	seed	1st weed	2nd weed	maize harvest
	granary empty	7	27	24	33	38	--
1)	cropping techniques:						
	- maize	--	--	--	--	--	87
	- premat harvest	--	--	--	--	5	47
2)	labour sale	2	9	16	17	30	2
3) 4)	remunerative acts and asset sales	4	18	19	28	29	3
5)	claims/transfers:						
	- gifts	1	5	7	21	22	5
	- credit	1	8	1	13	23	4
6)	dietary change:						
	- rationing	5	19	13	45	54	8
	- wild fd w/cereal	--	--	5	6	17	1
	- wild food only	--	--	--	6	17	--

7.4 Coping Strategies of Bèlèdugu Households by Food Security Group

As argued in Chapter VI, small, poor, newly-established households tend to be at greater risk of food insecurity especially in the context of drought-induced cereal shortage. Contrariwise, the well-established position of large, wealthy households vis à vis the production process and social networks of exchange, minimize their risk of food insecurity irrespective of rainfall sufficiency. Indeed, in some cases, the endogenous attributes of this group facilitate accumulation in conditions of widespread food shortage. The following section considers why the above associations exist by examining differences in the coping strategies of Bèlèdugu households using the food security classification scheme developed in Chapter VI.

Given that food security strategies are irrelevant to production sufficient households in Group 1, analysis is confined to the three remaining groups of production deficient households: the consumption secure (Group 2), and the moderately (Group 3a) and severely (Group 3b) consumption insecure. Both between and within group differences in the onset of food strategies, the amount of cereal procured from each strategy, and the number of food shortage days they supply, are considered using data from two consecutive soudure seasons of contrasting severity.

a) Cropping Techniques

Cropping techniques which involve the cultivation and harvest of maize and other early-ripening varieties are important yet calendar-specific strategies utilized by all food security groups. Harvested in late September (Table 7.11 in Appendix VI), consumption insecure households (Groups 3a and 3b) are forced to ration maize over a longer period of ~20-30 days compared to 15 days among consumption secure households (Group 2) (1988 $f=8.93$ $p<0.001$; 1989 $f=4.95$ $p<0.01$) (Tables 7.13a and b in Appendix VI)[7].

In contrast, the premature harvest of millet is a strategy of last resort in terms of the agricultural calendar and household preferences; employed during the latter stages of the soudure, its use increases with the severity of household food insecurity. In 1988, premature millet supplies 22 food shortage days among the severely consumption insecure (Group 3b) compared to 9 days among the moderately consumption insecure (Group 3a) and 7 days among consumption secure households (Group 2) ($f=7.03$ $p<0.01$). During the mild soudure of 1989, the use of premature millet decreases to 15 days among the severely consumption insecure which is indicative of its low preference in less acute circumstances (Tables 7.13a and b in Appendix VI).

As suggested in Chapter VI, the possession of choice agricultural land, productive assets such as plough and oxen, and a large and diversified labour force well-integrated into social and economic networks of exchange represent important determinants of food security as they permit the cultivation of large areas in a variety of micro-environments. By contrast, the poverty, social isolation and small labour force associated with food insecurity limits opportunities to expand production through the purchase of agricultural equipment, the hiring of wage labour or the exploitation of upland and lowland environments. In keeping with

[7] In a number of severely consumption insecure households, no maize was cultivated as the seed had been consumed as early as the dry season for want of cereal (household #'s 221, 205).

Raynault's (1975) observations in Maradi, Niger, the food insecure in the Bèlèdugu tend to farm peripheral holdings in terms of location and soil fertility. Indeed, the system of land rights among the Bamana whereby the first clearer of the bush becomes the owner often discriminates against households recently established in the village (Lewis 1979).

b) Labour Sale

Like the harvest of premature millet, labour sales are increasingly relied upon as risk of food insecurity increases. Among the severely consumption insecure (Group 3b), labour sales provide a full month of cereal in both 1988 and 1989 compared to two weeks among the moderately food insecure (Group 3a) and one week among the consumption secure (Group 2) (1988 f=6.63 $p<0.01$; 1989 f= 4.55 $p<0.05$). Not only do labour sales commence much earlier in severely food insecure households (Table 7.11 in Appendix VI), they also supply significantly more cereal: 36 kgs/cu in 1988 compared to ~6-7 kg/cu in Groups 2 and 3a (f=10.63 $p<0.0001$) (Tables 7.12a and b in Appendix VI). Low market prices for cereal most probably account for the absence of group differences in 1989.

In 1988, severely insecure households (Group 3b) devote four days/cu to labour sales compared to two days in Group 3a and one day in Group 2 (f=20.4 $p<0.001$). Given the significantly smaller labour force typical of production insufficient households ($p<0.01$), the cost of labour sale to domestic agriculture is even more considerable among the severely insecure. Many such households relate how they are forced to abandon large areas to weeds given insufficient time and labour thereby provoking food shortage the subsequent year.

c) Remunerative Activities

Remunerative activities provide an important means of securing cereal for both consumption secure (Group 2) and severely consumption insecure households (Group 3b). In the case of consumption secure households, the consistent success of remunerative activities in both 1988 (15kg/cu) and 1989 (18kg/cu) is evidence of the strong and diversified productive base which characterizes this group. As Chapter VI observes (6.3 iv), this group typically relies on other productive activities to supplement agricultural production in both good years and bad.

Contrastingly, the use of remunerative earnings among the severely consumption insecure is more a reflection of necessity than normal behaviour. The sharp decline in the quantity of cereal procured in this manner from 1988 (24 kg/cu) to 1989 (8 kg/cu) suggests that this strategy is abandoned when circumstances permit due to the substantial investment of time and money that these activities involve (Tables 7.12a and b in Appendix VI).

d) Asset Sales

In 1988, asset sales vary inversely with increasing food insecurity. The most productive strategy among consumption secure households (Group 2), asset sales supply 22 kg/cu compared to 16 kg/cu and 12 kg/cu among food insecure Groups 3a and 3b respectively. No doubt this is a reflection of the greater wealth in the consumption secure group ($f=6.16$ $p<0.001$), and their possession of surplus livestock to sell. In 1989, the quantity of cereal obtained through asset sales decreases in Groups 2 and 3a, but increases among the severely consumption insecure. However, this may be an artefact of lower cereal prices in 1989 which permit the purchase of larger quantities of cereal per asset sale (Tables 7.12a and b in Appendix VI).

e) Claims and Transfers

Like asset sales, an inverse trend is apparent between the supply of cereal via claims and transfers and increasing food insecurity. Regardless of the severity of shortage, gifts are the second most important source of cereal among consumption secure households (Group 2), providing 15 days of cereal consumption in both 1988 and 1989. In the moderately insecure group, cereal gifts supply 12 days of food shortage in 1988 and 8 days in 1989. Gifts are a relatively minor source of cereal among the severely consumption insecure (Group 3b) supplying only 5 days of shortage in 1988. This increases to 14 days in 1989 such that cereal gifts take fifth place after labour sales, early-ripening maize, market purchases with the proceeds of remunerative activities and asset sales, and the premature harvest of maize and millet (Tables 7.13a and b in Appendix VI).

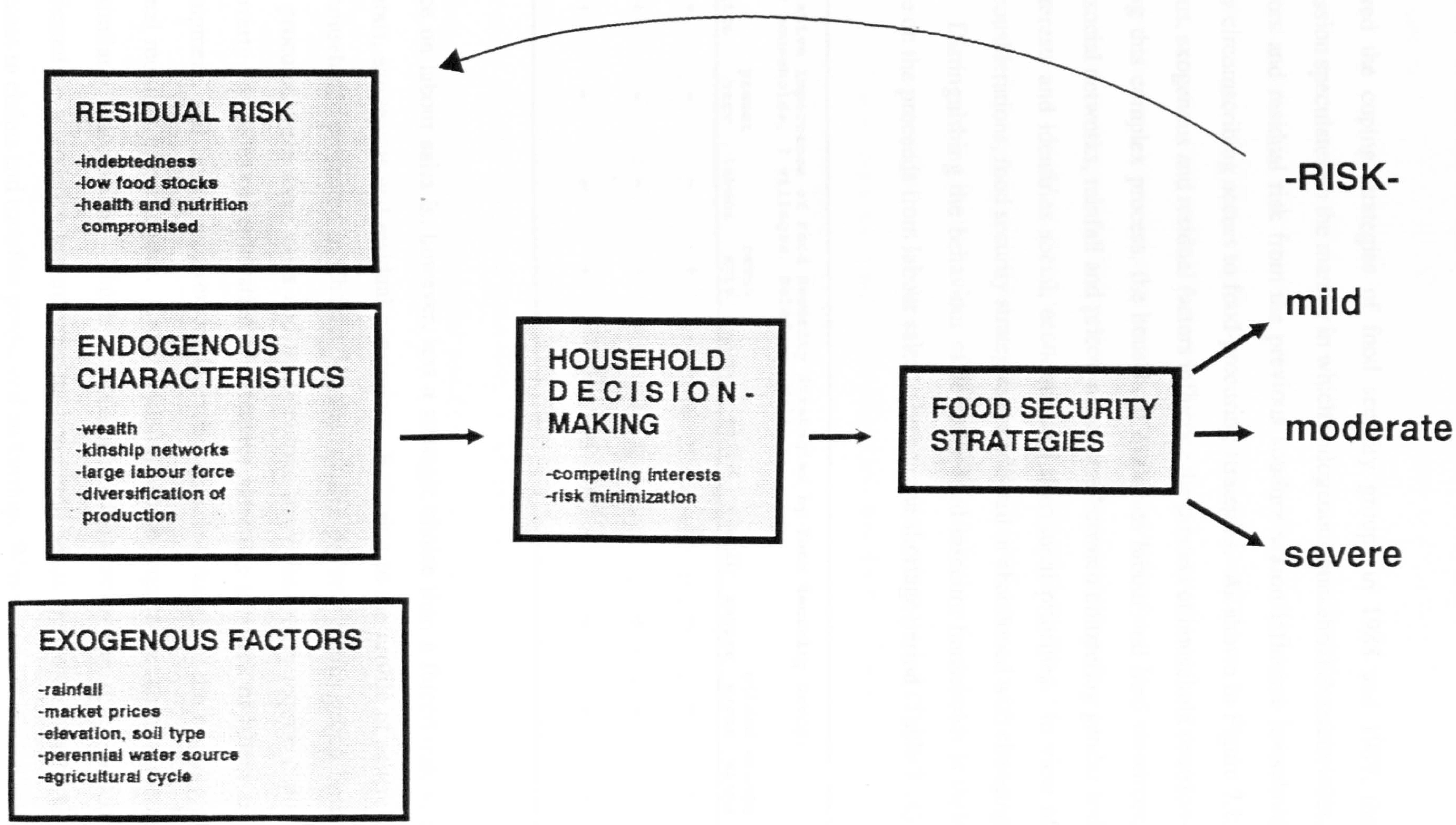
The relative disadvantage of the severely consumption insecure group is also reflected in the mean quantity (kg/cu) of cereal gifts they receive. In 1988, gifts provide only 6 kg/cu of cereal, compared to 12-13 kg/cu among consumption secure (Group 2) and moderately food insecure (Group 3a) households. In 1989, the quantity of cereal gifts remains unchanged in Group 2, and decreases in Group 3a. Among the severely consumption insecure (Group 3b), the quantity of cereal gifts/cu received does not vary from 1988, however, in 1989 it is rationed over a longer period (Tables 7.12a and b in Appendix VI).

As with the case of gifts, consumption secure households (Group 2) appear better placed with respect to credit networks. Relative to other groups, they receive larger quantities of cereal as credit both with and without interest. However, these differences are not significant. As suggested in Section 7.3, given the Bamana farmer's aversion to repaying debts in cereal or money with interest attached, cereal credits tend to be resorted to later in the agricultural season. In this respect, the generalized decrease in the quantity of cereal taken with interest in 1989 may be considered a consequence of the milder soudure conditions in that year.

f) Dietary Change

In Chapter VI, dietary change is used as an indicator of household food insecurity. Consumption secure households (Group 2) are defined by an absence of dietary change during the shortage period. Among the severely food insecure (Group 3b), rationing occurs on ~100 food shortage days in 1988 compared to 30 days among the moderately food insecure (Group 3a). In 1989, this decreases to 80 days in Group 3b but remains the same in Group 3a. Among severely insecure households, the supplementation of cereal with wild foods decreases from two weeks of shortage in 1988, to one week in 1989. In a like manner, while the exclusive consumption of wild foods is necessitated on four shortage days in 1988, this decreases to less than one day in 1989.

Figure 7.1 Residual, Endogenous and Exogenous Influences on Household Food Security



7.5 The Influence of Endogenous, Exogenous and Residual Factors on Household Food Security

Having compared the coping strategies of food security groups in 1988 and 1989, the following discussion speculates on the manner in which endogenous household characteristics, exogenous factors and residual risk from the previous soudure season influence household food security by circumscribing access to food-procuring strategies. As shown in Figure 7.1, these endogenous, exogenous and residual factors influence the process of household decision-making. During this complex process, the household evaluates labour and land resources, asset holdings, social networks, rainfall and prices, negotiates between competing gender and generational interests and identifies social, economic and nutritional priorities. In view of these dynamic considerations, food security strategies are adopted or abandoned with changing circumstances. Distinguishing the behaviour of severely food insecure households is their primary reliance on the proceeds from labour sales to breach the shortage period (Table 7.14).

Table 7.14 Relative Importance of Food Security Strategies by Food Security Group: 148 households, 7 villages, Bèlèdugu, Mali

group	maize	premat harv	labour	remun acts	assets	gifts	credit	ration	wildfd w/cer	wildfd alone
consumption secure (2)	+	-	-	+	+	+	+	-	-	-
moderately insecure (3a)	+	-	-	-	+	+	-	+	-	-
severely insecure (3b)	+	+	+	+	-	-	-	+	+	+

This dependence on labour sales is, however, less a strategic choice than a forced outcome due to endogenous, exogenous and residual constraints. Referring to the profile of severely food insecure households presented in Chapter VI, the relative poverty of this group limits access to food procured from asset sales and remunerative activities which require capital investment. Poverty precludes the cultivation of extensive areas due to a lack of labour and agricultural equipment, and limits involvement in exchange networks given the scarcity of money and cereal required to participate. Credit transfers which require wealth to serve as collateral are similarly inaccessible. The less established character of the severely food insecure as indicated by a tendency toward younger household heads and fewer nearby kin also impedes access to claims and transfers predicated on kinship. Without social or economic influence, the severely insecure are often allocated peripheral lands and excluded from village-level decision-making.

The severely food insecure are made even more vulnerable by the residual risk they inherit from the previous soudure season. Indeed, efforts to reconstitute assets and repay debts contracted in 1988 may account for the lack of investment in remunerative activities in 1989. In the context of successive crop failures, the viability of food insecure households may be further jeopardised. Interhousehold tensions stemming from the preoccupation with immediate household subsistence challenge household cohesion. In failing to satisfy subsistence needs, the household becomes an increasingly unviable socio-economic unit, and in extreme cases, household fission or disintegration may occur. In household #402, the severe drought of 1983-4 provoked the permanent migration of five brothers and their families to distant regional centres in search of better prospects. Following this same drought, the head of household #203 lost four grown sons to permanent migration, thereby reducing the household labour force to a vestige of its former strength.

Moderately insecure households (Group 3a) mainly rely on early-ripening maize, asset sales and cereal gifts to breach the soudure food gap in 1988. The predominance of these strategies are most probably explained by trends toward greater wealth and proximity to kinship networks compared to severely insecure households (Group 3b). In 1989, gifts and asset sales are replaced by labour sales in terms of importance. Residual risk from the previous soudure season may account for this change in behaviour as households attempt to regenerate or preserve remaining assets after the substantial loses incurred in 1988.

Among consumption secure households (Group 2), the shortage period is breached through a combination of remunerative activities, sale of surplus assets, cereal gifts and the harvest of early-ripening maize. Given the greater wealth and closer proximity of kin in this group, negligible costs are associated with these food-procuring strategies. Indeed, they are an integral part of normal household subsistence given the value this group places on productive diversification (Table 7.14).

Irrespective of food security group, all households are subject to exogenous factors over which they have little control. Just as rainfall variability influences risk through its impact on crop yields, and village location circumscribes accessibility to strategies, the market also influences risk by determining the availability and price of cereal. Apart from traditional strategies such as dietary change and non-market claims and transfers, labour sales, remunerative activities and asset sales all involve the purchase of cereal on the market. However, as in the rest of West Africa, cereal markets in Mali are both unstable and susceptible to manipulation at all levels: from collusion between local traders, to national cereal liberalization programmes (Chapter III), to fluctuating international commodity prices.

It follows that the greater a household's reliance on food purchases, the more vulnerable it is to the vicissitudes of the market. Typically, prices reach their apex during the soudure season when food insecure households are dependent on purchased cereal, and plummet in the post-harvest season when the groundnut crop is sold to cover taxes, debt repayment and social expenditures. In 1988, the price of millet on the market rose approximately 250% from the post-harvest period to the height of the soudure. This contrasts with a rise of only 150% in 1989 due to the greater availability of cereal in that year.

Given restricted access to non-market claims and transfers, severely insecure households are prematurely thrust into market exchange. Cereal is purchased at high prices or taken as credit at equally usurious interest rates. Together, climatic and market uncertainties conflate to push them into a continual reproductive squeeze characterized by asset depletion, cyclical indebtedness and a gradual slide into abject poverty (Watts 1983:264).

7.6 The Timing and Sequence of Food Security Strategies

Implicit to the sequential theory (Jodha 1975, Watts 1983, Cutler 1986, Corbett 1988) is the notion that a given strategy is employed and exhausted before the next strategy in the hierarchy is adopted. In contrast to this orderly step-wise model, results from the Bèlèdugu suggest that households pursue strategies simultaneously. For example, cereal rationing supplemented by the gathering of wild leaves may occur in tandem with the sale of livestock or labour undertaken to purchase cereal. Furthermore, the sequential argument does not reflect the unpredictable nature of certain food security strategies. The unexpected receipt of external food aid or cereal gifts from kin may occasion the abandonment of less preferred strategies such as rationing or labour sale.

The temporal character of certain food security strategies also complicates the simplistic notion that strategies are pursued in an orderly sequence of decreasing reversibility and cost to domestic resources. Cropping techniques such as the cultivation of maize and other early-ripening varieties and premature harvest always occur last by virtue of their seasonal specificity.

This temporal character is further manifested in the changing costs of pursuing certain food security strategies at different points in the food shortage season. For example, labour sale during the cultivation and harvest periods is less costly to domestic production than during weeding and seeding periods when time and labour are constrained. In a like fashion, the purchase of food with the proceeds of asset sales or remunerative activities may be less desirable at the onset of the soudure when grain prices are high, than at the culmination of the agricultural season when grain speculation is abandoned in anticipation of the new harvest.

A common theme in the sequencing literature is the notion that the 'reversible' curtailment of consumption through rationing and the gathering of wild foods is a first response to shortage which precedes the disposal of assets (Watts 1983, Dessalegn 1988, Corbett 1988). Corbett (1988:1108), for example, interprets rising levels of malnutrition as a necessary cost of the decision to preserve the asset base of the household and avoid actions that might impair its long-term income generating capacity. Particularly in the early stages of shortage, Corbett contends that economic objectives take precedence as the household chooses hunger over destitution.

However, there is little evidence to support these claims in the Bèlèdugu. As Table 7.15 indicates, household rationing is not confined to the early stages of shortage, but occurs throughout the soudure season. Table 7.15 also indicates that other food-procuring strategies such as asset sales, remunerative activities and labour sales precede the rationing of household consumption in every household but one (#204). Indeed, to undertake household rationing as a first response to shortage makes little sense given the energy demands of the agricultural calendar. During the energy expensive period of cultivating, seeding and weeding, rather than ration, Bèlèdugu households are more inclined to maintain or even increase household consumption through any means available to them (Chapter V). Later in the agricultural season when work is less intense, households may be more disposed to rationing. Efforts to avoid the consumption of wild foods to supplement or substitute scarce cereal rations further support the primacy of household nutrition in decision-making of Bèlèdugu households. The substitution of wild foods in place of cereal is considered a humiliating last resort to meet nutritional objectives and hardly a means of conserving the household's asset base. This view is confirmed in a survey of cultural perceptions whereby asset sales are ranked above wild food consumption in order of preference. Cropping techniques are rated the most preferred, followed by remunerative activities and claims and transfers, whereas asset sales, credit and wild food gathering are the three least favoured strategies in order of decreasing preference.

Table 7.15 Sequencing of Strategies among Households Consuming Wild Foods for 2 or More days in 1988: Bèlèdugu Mali

```
       clear/cultivate     seed                    1st weed                 2nd weed          maize     premature millet
       early   mid   late  early    mid    late    early    mid    late     early     mid     late      early     mid   late
hhold  JUNE                JULY                    AUGUST                   SEPTEMBER                   OCTOBER
202                                                                       X-credit-wldfd-gift-ration-maize-ration-premat/mil
204                         X-gift-----------------gift------------wldfd----gift------ration-gift-------maize
205----buy--ration---buy---------------------------credit-------------------wldfd-----premat/maize
206    X-buy---------------------------------------ration----------wldfd----gift------premat/maize------ration----premat/mil
212----buy-----------------------------------------buy-------------buy------ration----wldfd--maize-credit---------premat/mil
213                                        X-salary---------ration--------------------wldfd--premat/maize----gift-premat/mil
218                         X-gift--buy------------buy----------------------------------------wldfd--salary-ration--------buy
301            X-buy-ration-------------------------------------------------salary----wldfd-premat/maize
311----salary--ration----------------credit--------ration---wldfd--gift---------------credit--maize
409----buy-ration-----------salary-ration-buy------gift-------------------------------buy-wldfd-premat/mil
412                                  X-salary-ration------------------------wldfd-salary---wldfd-premat/mil
522                                                         X-gift-ration---buy-------wldfd---premat/mil
714                                                                X-wldfd--buy-------premat/maize
```

'X' denotes the onset of food insecurity; 'buy' refers to the purchase of cereal with the proceeds of asset sales or remunerative activities

As the preceding discussion has indicated, many factors influence which strategies are adopted, to what degree and in what sequence. Myriad endogenous, exogenous and residual factors bear on the process of household decision-making, the complexity of which belies attempts to find archetypal patterns of household behaviour. This is not to argue, however, that food security strategies are adopted in a random or haphazard fashion. Rather, strategies are pursued opportunistically with an over-arching view to minimize adverse nutritional and socio-economic risk. The particular sequence of strategies a household adopts will depend on the timing and severity of the food crisis it is experiencing, on the options available to the household given its particular demographic, social and economic attributes, and its location vis à vis favourable agricultural lands, and cereal and labour markets, and the extent of residual risk inherited from the previous soudure season. Opportunities are continually reassessed in terms of their social and economic desirability, the commitment of time and labour they require, and in terms of the competing social, economic and nutritional interests within the household.

CHAPTER VIII: CLAIMS AND TRANSFERS DURING SHORTAGE

8.0 Introduction

The Bamana farmer's capacity to cope in an environment of climatic risk and food insecurity is not unlike the adaptive flexibility of the pre-capitalist peasant farmer described by Scott (1976). According to Scott, the peasant household living at the subsistence margin had little scope for the profit maximizing calculus of traditional neo-classical economics. Rather, a risk-adverse or safety-first behavior was typically adopted whereby the peasant household chose to minimize the probability of failure over maximizing output (Scott 1976:4).

Scott argues that this safety-first maxim extended beyond the realm of risk-adverse agronomic practice to the social and moral arrangements of the pre-capitalist agrarian order (Scott 1976:4). Incorporated into the social superstructure of the peasant village were welfare and insurance mechanisms which worked to maintain collective subsistence security. Scott contends that this desire for subsistence security was socially experienced as a pattern of moral rights or expectations - hence the term 'the moral economy of the peasant'.

Opinions differ on whether a 'moral economy' still operates in the Sudano-Sahelian zones of contemporary West Africa. A number of authors contend that the colonial triad of taxation, export commodity production and monetization have brought about its demise (Watts 1984:133, Raynault 1975, Swindon 1988). Contrariwise, field studies among Bamana farmers in Mali indicate the persistence of non-profit rationales in decision-making and the continued vitality of reciprocal and redistributive arrangements despite the penetration of commodity relations into the rural community (Lewis 1979, Toulmin 1986, Becker 1989:49)[1].

This chapter examines the nature of the moral economy in rural Bamana society, focussing on food 'claims and transfers' and their social and material importance in overcoming seasonal

[1]Klaus argues that the resilience of the traditional economy is due to the slow penetration of commodity relations into rural Mali. He attributes this to the low levels of external investment in the rural community, and to the inability of the peasant farmer to accumulate in an exploitative and risky environment (Klaus 1976:72).

food insecurity[2]. It argues that while a 'subsistence ethic' still exists, it has evolved in form and content with changing environmental, social and economic circumstances. In short, its focus has shifted outward from the traditional core of kinship-based reciprocity to wider dyadic orbits which include migrant kin in urban areas, merchant traders and the state.

To provide context to the discussion of the nature and content of claims and transfers in the Bamana village, the chapter begins by examining social relations both within and between the households that constitute the village community (Sections 8.1 and 8.2), and beyond to extra-village relations in the locality and in the larger spheres of market and state (Section 8.3). Section 8.4 analyzes four categories of food claims and transfers in terms of the nominal rules and obligations surrounding them, and their quantitative contribution to household subsistence. A discussion of the nature and material importance of food claims and transfers in the context of scarcity follows in Section 8.5. To conclude, a spatial model is developed in Section 8.6 which situates households most vulnerable to food insecurity in relation to the social and economic networks through which food claims and transfers operate.

8.1 Social Relations within the Household

The Bamana household is a dynamic social and economic entity involved in a continuing process of change in the number and identity of its members, in their age and relationship to each other, and in their productive capability and consumption requirements (White 1980:19). Given fluctuations in demographic composition and rainfall, the typical household experiences periods of food deficit and surplus throughout its lifecycle (Fortes 1949, Goody 1958).

Representing the locus of production, reproduction and consumption, the Bamana household is comprised of the household head (*dutigi*), his wife(s) and children, and the wives and children of younger agnates. As the most senior member of the household, it is the household

[2]The expression 'claims and transfers' is preferred to the terms 'sharing' or 'exchange' as it best expresses the contractual nature of transactions between individuals or groups in Mande society. The moral code sanctions the right to make **claims** on others. The **transfer** that follows refers to the shift in the control over, or rights in, an economic good from the giver to the receiver (Laughlin 1974:383).

head's duty to control and organize the production and reproduction of household labour in the interests of collective subsistence. In the effort to ensure a large and productive labour force, he checks the fissioning tendency of the household through his control over the marriage alliances of progeny, over women and compound level goods such as production, land and other property and use rights (Becker 1989, Lewis 1979, Turrittin 1988, Toulmin 1986)[3].

Indeed, all household members have rights and obligations with respect to the production and reproduction of the household. This is not to suggest, however, that the household acts as a unified social and productive unit in pursuit of its collective welfare (Guyer 1981). Many segments of the household, such as married women or younger brothers and their families, have social and economic goals independent of the collective group. Depending on the degree to which an individual or segment has forfeited their rights to its benefits, the household group can act as a safety-net to risk-taking activities such as cash cropping or migration undertaken for personal gain. In this respect, the larger household provides an economy of scale for subdivisions within it (Richards 1986).

In short, social relations at the household level are marked by both complementarity and conflict (Becker 1989:35). Common rights and obligations toward the subsistence security of the household collective are in continual tension with the desire to be free from the patriarchal authority of the *dutigi*. Some of these rivalries (*fadenya*) are harnessed and controlled through the operation of village-wide age-set associations. Comprised of groups of contemporaries which cut across lineage boundaries, within the age-set egalitarianism and unity predominate such that a check to the conflictual, hierarchical organization of the household is provided (Lewis 1979:9).

[3]The trend toward the breaking up of large kinship-based production units was noted as early as 1934 by French colonial anthropologists (Labouret 1934:63). The growing individualization of production caused by increasing labour migration and individual financial incomes earned through cash-crop production and market activity are factors perceived to weaken the traditional strength of the household head and promote fissioning of the traditional extended household into smaller nuclear units (Paques 1954, Brasseur 1961, Klaus 1976).

8.2 Social Relations at the Village Level

Reminiscent of Scott's moral economy, social relations at the village level work to collectively ensure the subsistence of member households. Broadly speaking, the Bamana village community can be seen to comprise four main groups. The first group consists of households with strong patrilineal ties within the village[4]. Non-lineage households without genealogical roots in the village form the second social group in the Bamana village. The third group is comprised of special caste households (*nymakala*), while the fourth includes outsiders or temporary residents among which are the households of public servants and transhumant Fulbe and Moor populations. The physical and social characteristics of the village are the expression of relations within and between these groups.

Table 8.0 classifies Sèbèkoro households into lineage, non-lineage and caste groups. Non-lineage households are distinguished by the degree to which they have integrated into lineage networks through marriage.

Table 8.0 Lineage Classification in Sèbèkoro: n=33 households

lineage hholds n=14	non-lineage hholds: in lineage network n=9	non-lineage hholds: no lineage network n=12	caste hholds n=1
chiefly lineage: 201 203 205 207 224 227 232 233 other lineages: 206 208 209 210 ostracized:[1] 204 221	213 217 218 220 223 225 231	202 211 212 214 215 219 222 226 228 229 230	216 (smith)

[1] Past disputes with the chiefly lineage have meant that these households are largely excluded from lineage networks.

[4]Households possessing the same lineage name (*jamu*), and able to claim descent through males to a common male ancestor, constitute a patrilineal descent group. This group is an extension of close kinship.

a) Lineage Households

The patrilineal or 'lineage' group consists of long-established households with ancestral ties dating back to the origins of the village. The village chief (*dugutigi*) generally represents the most senior member of the founding lineage of the village. He occupies a strategic role in the adjudication of village social relations. With the counsel of village elders (*fakorobaw*), he administers and distributes land to community members, sets the main stages of the agricultural calendar, acts as the community representative to regional government and arbitrates in cases of dispute (Klaus 1976:57).

Within the lineage group, mutual aid between common lineage segments is considered obligatory; more wealthy households providing an informal welfare guarantee to poorer kin. Examples from Sèbèkoro are the patron roles of the chiefly lineage (#201) towards household #s 232 and 205 and the assistance provided by #210 to '*jamu*' kin in household #220. In both cases, chronic illness such as leprosy and blindness have compromised the labour force of these poor households to the point that self-sufficiency in cereals is impossible to attain.

b) Non-lineage Households

Non-lineage households tend to be more recently established in the village. Lured by economic opportunities or the promise of better farming prospects, these households have generally joined the village through the auspices of a patron within the lineage group who provided initial lodging and support to their request for land. At the same time as the absence or fledgling nature of kinship ties and obligations to other village households gives non-lineage households greater latitude in productive decision-making, it also exposes them to greater risk in the event of crisis. For this reason, non-lineage groups may try to access social networks within the village through marriage, while at the same time, maintain some of their older alliances through child fostering and seasonal visits to their villages of origin (*so denw*)[5].

The non-lineage household may also choose to invest in reciprocal relations with friends and neighbors as much as they feel it benefits them. Relationships between neighbouring non-lineage household #s 225 and 231, 214 and 213, and 218 and 217 are affirmed through labour and cereal exchange, as well daily favours in the form of small gifts of food, tobacco and cola nut.

c) Caste Households

Special caste groups (*nyamakala*) occupy a unique position in the Bamana community. While the smiths (*numuw*), bards (*jeliw*), carvers (*kule*), and leather workers (*garankew*) which make up the nyamakala constitute a separate race, they are indelibly incorporated into Mande life (McNaughton 1988:3). Owning the rights to arcane, spiritual and technological practices, they provide special services to the population. The Bamana farmer (*horon*) considers them a lowly race similar to the slave class (*jonw*) of the pre-colonial period, however, their special powers afford them a privileged place in the Bamana social relations.

d) Outsiders

The fourth group consisting of public servants (teachers, nurses and extension workers) and transhumant groups have a temporary and tenuous role in the village community. Public servants generally remain apart due to their outsider status reinforced by differences in lifestyle and lineage. In certain cases patron-client type relations may be established between

[5]The practice of child-fostering is widespread in West Africa (Bledsoe et al. 1988). Most frequently, childless or elderly women are given a child of matrilineal kin. In the village of Sebekoro, foster children were bequeathed to childless women in household #'s 228, 233 and 224, and to elderly women in household #'s 201, 213, 216, 226 and 232.

this group and village households, however, integration into institutionalized social networks rarely occurs[6].

Transhumant Moor and Fulbe groups may join the village for short periods of time to help with the harvest or to tend village herds. Moor families migrate southward from the Sahel at the beginning of the harvest season, establishing residence on the compound field (*soforo*) of a host household until the beginning of the rainy season. A mutual arrangement is made whereby the host household benefits from soils well-manured by Moor ruminants, while the Moors are given permission to gather remaining millet on the threshing grounds after the harvest. The winnowing services of Moor women are also solicited for payment in cereal.

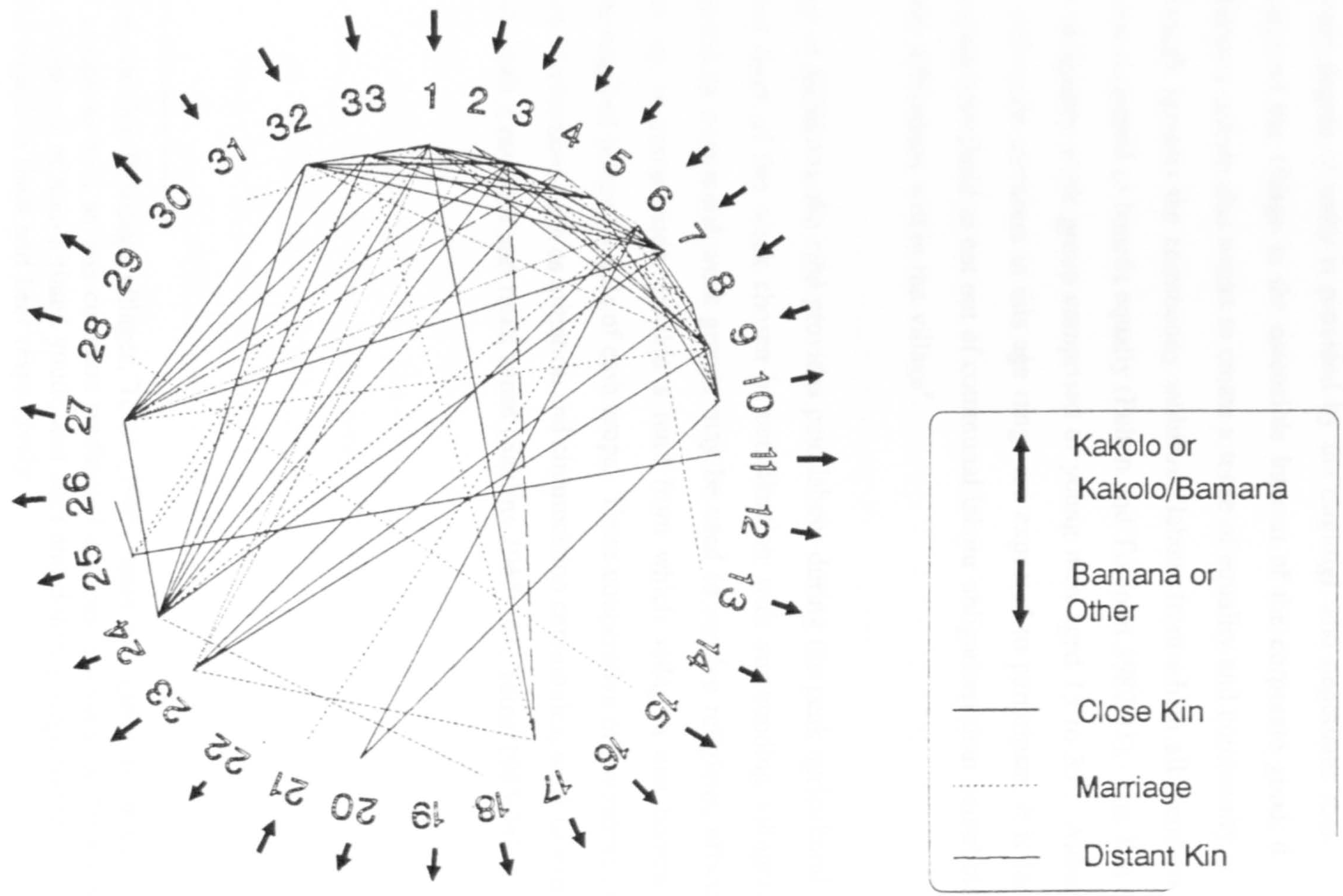
The nomadic Fulbe are generally the most temporary members of this last social group. Their presence in the village is often fleeting as they pause to water cattle during seasonal migrations. Occasionally, a Fulbe family may be hired to tend the cattle of a village household or group of village households. Establishing temporary residence on the periphery of the village, they receive cereal and the rights to milk on certain days as payment for their services.

At the same time as social relations between village households and Fulbe herders are symbiotic, they are ambivalent. While mutually beneficial exchanges of milk for cereal and the manuring of fields for fodder occur, the Fulbe herder looks with contempt at the pagan simplicity of the Bamana farmer, while the Bamana resent the frequent and sometimes willful destruction of near ripe millet crops by Fulbe cattle (Fulton and Toulmin 1982:182-4).

Figure 8.0 represents the web of alliances that exist between Sèbèkoro households; those based on common lineage (patrikin), and marriage ties (matrikin).

[6]By definition, patron-client relationships are imbalanced. One partner is clearly superior to the other in their capacity to grant goods and services (Wolf 1966:16).

Figure 8.0 Interhousehold Alliances in Sebekoro



e) Village-wide Associations

While a certain degree of unity is provided by the *dugutigi* who negotiates social relations within and beyond the village in the ostensible interest of the corporate good, the age-set system of Bamana culture also works to create a sense of equality and community within the village. Through age-sets the community mobilizes labour from which all members of the community are supposed to benefit equally (Fulton and Toulmin 1982:31). The Ton or *cibò* is one such obligatory work group comprised of young men aged 13 to 35[7]. Although all households with male members in this age range are expected to participate, it is far easier for a non-lineage household to opt out of communal labour obligations than households with strong kinship affiliations within the village[8].

In the village of Sèbèkoro, the *cibò* provides paid labour during the peak agricultural season on designated days of the week chosen in coordination with surrounding villages. The proceeds earned by communal work groups may be used to receive religious, official, and other visitors or, in some cases, provide a fund from which villagers can borrow if tax payments are required before the sale of cash crops. These cooperative organizations, as well as community celebrations such as initiation and circumcision ceremonies, work to sustain the community in both a material and ritual sense (Sahlins 1965:141, Teme 1985:95).

---

[7]In a study of five Beledugu villages, Teme (1985) notes the operation of *buranci* and *cibo* labour groups as well as less common traditional associations such as the *n'tomoci*, a work group composed of non-initiated youth, and *baci* and *doloci* groups formed on special occasions and repaid in meat and beer respectively.

[8]Despite having two eligible male workers, household #229 provides an example of a non-lineage household that chose to channel all its productive efforts into cash crop production rather than release its labour for communal work. Informal labour exchange between household #229 and its host lineage household #224 occurred during non-peak agricultural periods.

8.3 Social Relations Beyond the Village

Beyond the nexus of social relations within the village are those extending beyond the village into the immediate vicinity and further still to the state. Common in the Bèlèdugu are informal village federations (*kafow*) based on spatial proximity or shared descent (Teme 1985). Sometimes over-lapping with regional administrative divisions, these intervillage affiliations respond to the need for mutual cooperation concerning cropping schedules and other ceremonial and administrative matters.

Through marriage, social ties with surrounding villages are strengthened thereby further fortifying intervillage subsistence networks. Marriage is a collective affair in Bamana society, arranged between the parents of exogamous lineages[9]. Exception may be found in the case of returning migrants with wealth independent of the household head (*dutigi*) who may express preference for a wife, or choose one of his own initiative. In the village of Sèbèkoro, 24.1% of married women come from households within the village itself, 39.0% originate from surrounding villages within a 5 km radius of Sèbèkoro, while the remainder issue from more distant regional centres (22.1%), and beyond (14.8%).

Maintaining and developing social and economic networks through marriage is a matter of great importance even if it results in lost production in the immediate term (Fulton and Toulmin 1982:29). In-law or matrikin labour exchange (*buranci*) can be requested by the fiancée's household at any time during the process of brideprice payment including the peak agricultural season. The bridegroom must gather together members of his age-set to pay respect to his prospective father-in-law's household by providing a day of free labour. After marriage these links are maintained through visits of married women to their natal villages (*so denw*), and through exchanges of gifts and services.

In the long-term, established and stable marriage networks act as insurance against highly localized differences in farming fortunes. Indeed, flows of cereal along the marriage road

[9]The most common pattern is for a man to marry his cross-cousin who may be the daughter of one of his mother's brothers, or the daughter of one of his father's sisters. Marriage between patrilineal kin is forbidden (Fulton and Toulmin 1982:28, N'Diaye 1970:107).

(*furasira*) during periods of shortage are increasingly important with the weakening of intra-village lineage networks through household fission and migration. Given the long-term social and economic importance of matrikin networks, divorce or any other attempt to escape from the obligation of reciprocity is strongly resisted (Fulton and Toulmin 1982:30).

Of similar economic importance are social relations between urban migrants and village kin. Although it is difficult for the household to make and enforce claims on migrant kin located in distant centres, periodic remittances from them are critical sources of cash income that may be mobilized during the soudure season. Indeed, given the steady monetization of the rural economy, migration earnings have become vital to household viability (Giri 1989:75). In pursuit of cash income, the traditional migrant profile has been extended to include not only the young unmarried men, but unmarried women working as urban domestics to earn their trousseau and the elderly blind.

Relations with market traders (*dulaw*) are also of growing importance to the Bamana farmer. With the establishment of regional and local markets for cash crops, the trader has become an essential source of cash, credit and cereal for Bamana households (Klaus 1976:77). For villages located close to such markets, patron-client relations between trader and farmer are in some cases displacing traditional reciprocal arrangements between kin and neighbour. The recent government policy of market liberalization has further cemented relations between farmer and trader (Staatz et al. 1989).

Ranging from ambivalence to hostility, social relations between the village and the state are very much coloured by a village centered consciousness which prevails in rural Mali (Giri 1989:99). From the rural point of view, government actions such as the collection of taxes, fines for clearing fields, illegal hunting and bush fires are considered forcible expressions of interest unconnected with, and indeed opposed to, those of village society (Fulton and Toulmin 1982:35). The little compensatory social security and infrastructure provided by the Government is underfunded and overextended. Basic medical services are found only in larger villages, and schools are considered a diversion of valuable labour resources away from domestic production and thereby a threat to household viability.

On the part of government, rural areas are considered backward and unwilling to innovate. Indeed, Klaus describes how massive state investments in modernizing traditional agriculture in the 1960s met with failure; "production of the most important food cultures - millet and rice - stagnated or decreased" (Klaus 1976:80). In the Bèlèdugu region, state-level food relief and agricultural extension remain limited. With the demise of *Opération de Developpement Integré pour la Production Arachidaire et Cerealière* (ODIPAC), for the most part, non-governmental organizations (NGO's) are alone in providing funds for village development projects such as food banks and agricultural credit schemes. The Catholic mission in Kolokani and Italian and Dutch NGO's have been particularly active, however, their efforts are extremely localized leaving large areas of the Bèlèdugu completely unserviced.

8.4 Claims and Transfers in Bamana Society

The preceding discussion of social relations within Bamana society has provided some context for a more detailed examination of the cultural dimensions of food claims and transfers and their material importance in enhancing the subsistence security of rural households.

Sahlin's notion of a 'continuum' of exchange provides a useful conceptual basis in this task (Sahlins 1965). Influenced by Malinlowski's classification of Trobriand exchanges based on balance and equivalence, Sahlins has conceptualized reciprocity in 'primitive' societies as a 'continuum' of exchange; the different modes of exchange being conditioned by the degree of tolerance for material imbalance as indicated by the time allowed to reciprocate[10]. Thus, at one extreme is 'negative reciprocity', an impersonal form of exchange in which participants confront each other as opposed interests, each looking to maximize utility for themselves at the other's expense (Sahlins 1965:146).

'Balanced reciprocity' describes transactions which stipulate returns of commensurate worth or utility within a finite and narrow period (Sahlins 1965:146). Although parties confront each other as opposed interests, there is a social side to the transaction such that 'relations between

[10]For Sahlins, the primitive exchange economy is characterized by a domestic mode of production and a social order based on kinship which have been unmodified by the historic penetration of states (Sahlins 1965:140-141).

people are disrupted by a failure to reciprocate within limited time and equivalence leeways' (Sahlins 1965:148).

'Generalized reciprocity' is the solidarity extreme where the material side of the transaction is repressed by the social. "Reckoning of debts outstanding cannot be overt and is typically left out of account" (Sahlins 1965:147). Expectations of the time, quantity or quality of reciprocation are indefinite and often relate more to the needs of the donor and recipient than to equivalence to the initial transaction.

A discussion of the particular nature of social and economic exchange in the Bamana village must take into account both the normative character and actual content of specific food claims and transfers. As Johnson and Bond (1974) suggest, it is necessary to go beyond the formality of social structure and to quantify what is actually being accomplished[11].

The following analysis will therefore consider the normative rules and obligations surrounding food claims and transfers as well as their specific content. Using quantitative and qualitative data from the Bèlèdugu, the identity and attributes of the various partners in exchange will be assessed both in terms of kinship, wealth and residence, and in terms of the value, quantity and frequency of the particular entities being exchanged.

Food claims and transfers can be divided into four categories, ritual homage and alms; gifts; and exchange and credit. These vary in relative importance according to village location, tradition, household lifecycle, season and intensity of shortage. The mode of food claims and transfers may be direct: a transfer of immediately consumable food; or indirect: an exchange of capital or labour resources from which food can be obtained (Cadelina 1985:85).

---

[11]Comparing the Muyombe of Zambia and the Boa Ventura of Brazil, they note surprising differences between normative expectations concerning the exchange of goods and services and actual patterns of interaction. While the Yombe view their social order as one based on the rights and duties of kinsmen, strong informal ties of cooperation and trust are formed outside their set of kinsmen. Likewise, among the Boa Ventura where individual will and self-interest are said to override kinship obligation, ties of friendship between kinsmen were found to be important (Johnson and Bond 1974:66).

a) Ritual Homage and Alms

In the Bamana village, ritual homage and alms are moral and/or religious duties required of Animist and Muslim believers alike. Animist sacrifices of animals and cereal to ancestral priests for good fortune in farming and homage paid to the blacksmith (*numu*) or traditional praise-singer (*jeli*) are examples of ritual transfers in the traditional Bamana village.

The 'Sudanized' version of Islam that has spread through most of rural Mali has introduced the religious practices of almsgiving and charity for the destitute (zakkat or *jaka* in Bamana)[12]. In some instances these practices co-exist with traditional transfers to kin and ancestor cults alike, while in others they have transformed them. Offerings to cult priests are provided to Muslim clerics (*moriw*) instead, or in the case of Sèbèkoro, to elderly or infirm relatives thereby fulfilling obligations to kin and Allah simultaneously (Trimingham 1959:189).

Unlike Sahlins' 'generalized reciprocity', ritual transfers entail a moral or religious obligation to give but not to receive. Quite different from an act of altruism, almsgiving is performed for the welfare of one's soul by claiming superior status in the eyes of God, or to assure prosperity in farming. Both Animist and Islamic forms of homage and almsgiving presume that the household has an economic surplus over subsistence needs to distribute (Trimingham 1959:184). Data from Sèbèkoro indicate a strong positive correlation between production and almsgiving ($r=+0.79$ $p<0.001$). It remains, however, that a number of food insecure households gave a large percentage of their scanty harvest away as alms despite the clear impact these gestures have on long-term food security.

Tables 8.1 and 8.2 summarize household cereal flows in the village of Sèbèkoro. Homage and almsgiving constitute 9.7% of mean agricultural production in Sèbèkoro, most of which is disbursed as zakkat (*jaka*) following the harvest to the elderly and destitute residing in surrounding villages, and to roving Muslim clerics (Table 8.1). Of reported homage and alms transfers, clerics (26.1%), the destitute (17.4%), representatives of ancestral spirits (13.8%) and the blacksmith (7.2%) are the most frequent recipients.

[12]Islamic law requires that 10% of annual production or income (zakkat), be distributed among the old, the infirm and the destitute.

Table 8.1 Cereal Outflows in Sèbèkoro (kg/hhold): n=33 households						
	mean	(sd)			Season:	
TYPE	ANNUAL OUTFLOWS		% PROD	HARVEST	DRY	RAINY
cereal sale	166	(255)	6.5	81	6	13
salaries given	162	(197)	6.3	146	2	14
consumption	2373	(1535)	93.0	767	768	838
debt repayment	42	(92)	1.6	15	24	1
alms given	248	(251)	9.7	225	21	2
gifts given	255	(364)	10.0	94	118	43
credit given	9	(28)	0.3	8	--	1
TOTAL	3253			1336	994	923

Inflows of homage and alms are generally associated with zakkat transfers and ritual and/or ceremonial gifts received by Sèbèkoro households in harvest and dry seasons (Table 8.2).

Table 8.2 Cereal Inflows in Sèbèkoro (kg/hhold): n=33 households					
	mean (sd)			Season:	
TYPE	ANNUAL INFLOWS		HARVEST	DRY	RAINY
cereal purchase	410	(589)	109	138	163
salaries received	65	(135)	31	26	8
production	2560	(2477)	2510	--	50
debt received	29	(98)	6	17	--
alms received	31	(171)	15	15	1
gifts received	181	(158)	34	21	126
credit received	177	(97)	4	--	113
TOTAL	3387		2709	217	461

b) Gifts

The second category of claims and transfers is the gift, an exchange of symbolic or tangible goods or services between two groups or individuals that carries with it some obligation to reciprocate. Gift exchange is an intrinsic part of Bamana social and economic relations. As a means of coping with the vicissitudes of climate, and the changing productive potential and consumption needs of the household over time, gift exchange allows the Bamana farmer to cultivate and convert social resources into a system of mutual insurance so that: "...he who is in need today receives help from he who may be in need tomorrow" (Evans-Pritchard 1940:85).

Gift behaviour is more likely to be found in communities where the kinship idiom prevails. The social bond of kinship tends to engender reciprocity freely given without a strict stipulation of return. However, in the modern Bamana village gift exchange is also used to assist and validate strong informal ties of cooperation and trust between individuals and households unrelated by kinship or marriage. In the following discussion, the nature of kin and non-kin forms of gift exchange in the Bamana village will be considered before evaluating specific examples of direct and indirect food gifts and their material contribution to household food security.

Kinship-based gift transfers may be materially important exchanges made in response to the needs and obligations of other kin, or symbolic gestures to affirm the importance of social networks, such as the small currency of meal-sharing and presents of cola nut and condiments. Reciprocation need not be immediate, nor must there be any necessary equivalence to the initial gift (Sahlins 1965:160). As Mauss explains in his essay on 'The Gift', in archaic societies, "To refuse to give, to fail to invite, just as to refuse to accept, is tantamount to declaring war; it is to reject the bond of alliance and commonality" (Mauss 1950:13).

Within lineage networks, the material flow of gifts may be unbalanced in favour of one side or another for an unspecified period of time. Indeed, this imbalance may be used to assert and maintain power relations within lineage networks. At the same time as gifts of millet or cash from more affluent kin assist food insecure lineage members, a claim for superior status is made by obligating the recipient to the donor household (Sahlins 1965:160). This claim is made by obligating the recipient to the donor household (Sahlins 1965:160). This claim is validated if the recipient fails to reciprocate with benefits that are at least as important to the donor as they are to the recipient (Blau 1967:108). Examples of power relationships mediated through gift giving in Sèbèkoro are found between the chiefly lineage #201 and poorer nephews in household #205, as well as between the more affluent lineage members of household #203 and near destitute cousins in household #232.

Given the spacio-temporal variability of cropping fortunes in this Sudano-Sahelian region, exchange relationships with lineage households from surrounding villages are also strategic. By virtue of field location, soil fertility, crop mix, seeding schedule or the timing and amount of rainfall received, the prevalence and intensity of food shortage may differ from one neighbouring village to the next. In this respect, the exogamous marriage alliances of the Bamana facilitate a risk-spreading broadening and diversification of social and economic networks beyond the village. For non-lineage households, marriage ties within the village or nearby vicinity provide an expedient way of creating local kinship links which might be relied upon in case of crisis. However, without an affinal tie binding donor and recipient, the non-lineage household has no sure claims on the return of any generosity provided (Lewis 1979:358).

Gift exchange between non-kin may also be a strategic source of cereal and other goods. Unlike generalized reciprocity between familial groups, however, dyadic contracts between non-kin require a more defined schedule of repayment. Although a minimal degree of affect is important to the 'dyadic' relationship, it will endure only as long as expectations of strict reciprocity and perceived self-interest are met (Foster 1961:61-64, Wolf 1966:12).

As shown in Table 8.1, 10.0% of annual millet production in Sèbèkoro is disbursed as direct cereal gifts to kin and household visitors. Much of this gift-giving occurs when agricultural activity has terminated and villagers are free to circulate. During the dry season, it is common for married women to return to their natal villages (*so denw*) for several months at a time. Beyond supplying visiting daughters with food and lodging for the duration of their stay, matrikin are obliged to give substantial gifts of cereal on their departure.

Whether kin or non-kin, Bamana tradition demands that visitors receive small cereal gifts and other gestures of respect. Indeed, as Toulmin observed in a Bamana community north of Segu, a similar increase in the frequency of visits from distant kin, praise-singers and travelling musicians was noted in Sèbèkoro following the plentiful harvest of 1989 (Toulmin 1986:65). The steep increase in gift-giving observed in the dry season (see Table 8.1) is also explained by the large quantities of cereal allocated to the preparation of festive meals for visitors attending village initiation and marriage ceremonies.

Of the 185 cereal gifts disbursed in Sèbèkoro over a year-long period, 9.2% went to visiting patrikin, 12.5% to visiting matrikin, 13.5% to visiting friends, and a further 28.1% to miscellaneous visitors. Remaining gifts went to relatives, friends and neighbours within the village (16.8%) or to unstated recipients (19.9%). As with offerings of homage and alms, the significant positive correlation between gift-giving and household production suggests that generosity may be a function of a household's productive strength ($r=+0.51$ $p<0.01$). However, the absence of a significant negative correlation between gift-receiving and agricultural production suggests that the food insecure in Sèbèkoro may not be the major recipients of that generosity ($r=-0.36$).

Money gifts from migrant kin represent another important direct food claim for households in the Bèlèdugu. During the rainy season months of June and July, a total of 10 households in Sèbèkoro received money gifts for cereal purchase; in seven cases these remittances came from migrant sons (in-law), in two cases from other kin. The mean value of these gifts was 24,000 FCFA, or the equivalent of 480 kgs of millet at rainy season prices.

Sustaining these more formal gifts of money and cereal is an under-current of smaller daily transactions of condiments, meals, tobacco and cola-nut which cement social relations between village households. During seasonal food consumption measurements in Sèbèkoro, these transactions were monitored (Table 8.3).

Table 8.3 Daily Transactions of Gifts Given in Sèbèkoro: % transactions per category

TYPE	OVERALL n=185	Season: HARVEST n=58	DRY n=78	RAINY n=49
meals	29.2	37.9	32.1	14.3
condiments	17.8	32.8	11.5	10.2
other foods	16.2	5.2	12.8	34.7
cola/tobacco	18.4	8.6	24.4	20.4
milk	6.5	1.7	2.6	18.4
cereal	4.4	7.0	5.0	----
money	7.5	6.8	11.6	2.0
TOTAL	100	100	100	100

Of small gifts given, 29.2% of transactions involved meal giving, followed by gifts of cola-nut or tobacco (18.4%) and condiments (17.8%)[13]. Most of these gifts were directed to friends and neighbours (43.2%) and post-harvest visitors (19.5%).

Table 8.4 Daily Transactions of Gifts Received in Sèbèkoro: % transactions per category

TYPE	OVERALL n=128	Season: HARVEST n=56	DRY n=39	RAINY n=33
meals	43.8	42.9	33.3	57.6
condiments	15.6	8.9	23.1	18.2
other foods	8.6	7.2	12.8	6.0
cola/tobacco	16.4	17.8	20.5	9.1
milk	5.5	3.6	5.1	9.1
cereal	7.8	17.8	----	----
money	2.3	1.8	5.2	----
TOTAL	100	100	100	100

Meals were the most frequently reported gift received (43.8%), followed by cola-nut and tobacco (16.4%) and condiments (15.6%). Once again, the majority of gifts came from friends and neighbours (44.5%), matrikin (18.0%) and patrikin (14.1%) (Table 8.4).

[13]Condiment exchange occurs between women, while tobacco and cola-nut represent the gift currency of men and older women.

Indirect forms of food assistance may also be provided through gifts of labour and/or agricultural equipment which benefit crop production. Table 8.5 outlines the different types of non-domestic labour in Sèbèkoro and the percentage of 'out-labour' days devoted to each. Of interest are the first three categories of labour exchange which fall under gift claims and transfers: patrikin, matrikin and charitable labour. Like matrikin (*buranci*) labour which is furnished at the request of the father-in-law (see Section 8.3), a similar obligatory ethic surrounds labour required by patrikin behind in their cropping schedule, or charitable labour provided to respected or destitute households without an expectation of return. Together, 'gift labour' accounts for 13.1% of total out-labour days in Sèbèkoro.

While less common, transfers of surplus equipment and animals between matrikin and patrikin also occur in Sèbèkoro. Lineage household #205 benefitted from the rainy season use of an oxen team donated by the chiefly lineage #201, while household #s 213 and 223 received teams from matrikin. Given the long-term nature of the loan, and the unspecified terms of its recompense, these indirect food transfers are in keeping with the spirit of the gift.

c) Exchange

Exchange is the third category of food claims and transfers. Resembling Sahlins' 'balanced reciprocity', inherent in the notion of exchange is the immediate return of goods and services rendered. Exchange claims and transfers are largely 'indirect' in the form of labour or non-food resources through which cereal can be obtained. In the village of Sèbèkoro, a great many labour arrangements in the village are organized on the principle of exchange. During the harvest period, groups of households form threshing teams which move between the fields of participants; exchanging labour to accomplish labour intensive agricultural tasks more quickly. In the dry season, kin or neighbouring households form similar work groups for the purpose of house repair and construction.

Table 8.5 Non-domestic Labour Exchange in Sèbèkoro: % out-labour days per category				
	n=33 households		Season:	
CATEGORY	OVERALL n=1452	HARVEST n=291	DRY n=325	RAINY n=836
patrikin labour	6.6	3.4	11.1	5.9
matrikin labour	2.3	---	1.2	3.6
charitable labour	4.2	5.5	1.2	4.9
cibò labour	27.8	---	24.9	38.5
community labour	21.7	1.4	19.7	29.5
labour exchange	25.6	72.5	31.1	7.7
labour sale	11.8	17.2	10.8	10.4
TOTAL	100	100	100	100

As Table 8.5 indicates, 25.6% of non-domestic labour days are devoted to labour exchange of this type, most of which occurs in the harvest and dry seasons. *Cibò* or age-set labour, which accounts for a further 27.8% of non-domestic labour days, embodies both exchange and market principles. Composed of youth representing most households in the village, the *cibò* is communal in membership and purpose; responding to the labour needs of village households during intensive ploughing and weeding periods. However, in the village of Sèbèkoro, reciprocation is neither immediate nor in kind. A half day of *cibò* labour can be requested on the condition that a 2500 FCFA fee be paid after the harvest. For food insecure households, this fee is often prohibitive, as is the obligation to feed *cibò* labourers when cereal is scarce.

Other dyadic labour exchange arrangements are common between kin and neighbour such as the loan of animals or labour for ploughing and other agricultural services. One such arrangement was made between household #220, consisting of a blind household head, his leper wife and three children, and lineage household #210. The labour of the eldest son was allocated to household #210 for the duration of the rainy season on the condition that they cultivate on behalf of the blind household. In another instance, in exchange for the use of their plough lineage household #209 agreed to tend the field of household #226, a food insecure household composed of an old woman, her school-aged nephew and foster child.

Inter-ethnic forms of exchange are also common in this Sudano-sahelian zone. Transhumant Fulbe exchange milk and labour for cereal cultivated by the Bamana; Moors temporarily settled on the periphery of the Bamana village exchange manure and labour for any millet left at threshing sites.

d) Credit

Credit transfers constitute the final category of food claims and transfers mobilized to prevent or respond to periods of food insecurity. Tending toward the 'negative' pole of Sahlin's spectrum of reciprocities, credit transfers demand a stricter schedule of repayment than other forms of exchange.

Depending on the degree of intimacy between partners, interest may be required in the transaction. Interest-free credit tends to be confined to donor agency credit schemes or transfers between partners of relatively close social span. In these instances, a type of delayed but 'balanced' reciprocity is exhibited where the loan is repaid in kind after an agreed period of time.

Closer to Sahlin's 'negative reciprocity' are credit transfers or loans mediated in the market-place for which interest must be surrendered. In a region where production is constrained, it has been argued that profits from grain marketing come from exploiting supply/demand discrepancies through hoarding and speculation (Hill 1972, Raynault 1975). Indeed, the market trader benefits greatly from soudure season credit transfers to the Bamana farmer. A typical loan taken during the soudure period must be repaid at seasonal interest rates varying from 50 to 250%[14]. For the food insecure household with no income but the sale of agricultural produce or labour, the subsistence consequences of such a loan are evident. A

[14]For example, if a cereal loan of 100 kg millet is contracted at 50% interest in the rainy season when prices average 100 FCFA/kg, repayment in the harvest season is 150 kg millet or 15,000 FCFA. The repayment of principal and interest on a money loan of 10,000 FCFA contracted on the same terms in the rainy season would amount to 15,000 FCFA, or its equivalent in millet at harvest season prices (300 kg at 50 FCFA/kg). For Muslim traders who heed Islamic laws against usary, interest may be collected in the form of labour.

'rachet effect' is exerted which drives the household towards permanent indebtedness and food insecurity (Raynault 1975, Harriss 1982, Chambers 1989).

As Table 8.6 indicates, in the Bèlèdugu region, the majority of cereal loans reported in 1988 and 1989 soudure periods are of the interest-free variety contracted with friends, neighbours, patrikin and village food banks.

8.5 Food Claims and Transfers During Shortage

A growing body of literature has associated a deterioration in normal patterns of social and economic solidarity with increasing food deprivation (Laughlin 1974, Dirks 1980, Firth 1959, Cadelina 1985). Like Firth's observations of heightened private consumption and "crypto-stinginess" among the Tikopea, Laughlin has noted a similar decrement of reciprocal exchange between So kinsmen and an enhanced reliance on rudimentary market exchange as food deprivation intensifies (Firth 1959, Laughlin 1974).

Dirks has conceptualized these social and economic responses to increasing scarcity into three successive stages of deprivation: alarm, resistance and exhaustion (Dirks 1980). In the alarm phase, or the early stages of shortage, an intensification of social and economic activity is expected. Reciprocity and assistance increase above pre-stress levels and productive alternatives are explored in the effort to supplement insufficient food stores. With the resistance stage, "social ties begin to erode; ...conservative measures are introduced that are antithical to widespread generosity and broad-based group action" (Dirks 1980:28). Sharing networks become increasing restricted to close kin and economic strategies increasingly short-term. Cooperative strategies are further eroded as deprivation reaches the exhaustion phase (Dirks 1980).

Given the delimited character of seasonal food shortage in the Sahel, it is unlikely that the latter stages of resistance and exhaustion are reached on a community scale unless successive years of drought are experienced. Nonetheless, it might be argued that the intensity and prevalence of seasonal insecurity will affect the valence of claims and transfers that the household may access. As Laughlin observes, during periods of shortage the decision strategies employed with kin and dyadic partner "will shift in focus from a concern with long-term maximization of payoffs, such as lineage solidarity and enhanced prestige, to a concern for immediate survival. People now desire to maximize goods, especially foodstuffs, of the most immediate utility" (Laughlin and Brady 1978:83). Furthermore, in conditions of increasing seasonal scarcity, the household might be expected to limit the risk of non-return by contracting the outer bounds of reciprocity both in terms of the value and frequency of transactions effected, and in terms of the partners with whom it interacts.

Data from two soudure seasons of contrasting severity provide an opportunity to explore these hypotheses. Recalling Figure 7.0 (Chapter VII) which expresses the relative importance of different food sources in terms of the percentage of food shortage days they furnish, together, cereal gifts (11%) and credit transfers (11%) supply 22% of food shortage days during the severe soudure period of 1988 relative to other food sources. Most of this credit (7%) takes the form of loans repaid in kind without interest. During the milder soudure period in 1989, a slight increase in the relative importance of cereal gifts (15%) is observed. While credit transfers remain the same (11%), unlike 1988, the majority (7%) involve the payment of interest. These results appear to suggest that in conditions of more widespread scarcity, cereal gifts contribute less to household food security than they would in less extreme conditions.

However, when the quantitative importance of cereal gifts and credits are compared between soudure seasons, a different impression emerges. In 1988, 27% of households in the Bèlèdugu sample receive food gifts compared to 13% in 1989. A similar difference in the number of households reporting credit transfers is observed: 30% in 1988 compared to 22% in 1989. As Table 8.6 indicates, the mean value of cereal gifts and credit also appears greater in the more acute soudure conditions of 1988. The large standard deviations observed are partly due to the wide variation in household size within the sample.

Table 8.6 Household Food Claims During Soudure Seasons in 1988 and 1989 (kg/hhold)						
7 villages, Bèlèdugu, Mali			mean (sd)			
		1988			1989	
FOOD CLAIM	n	kg	sd	n	kg	sd
cereal gift	40	270	(268)	19	280	(286)
cereal credit	44	305	(409)	33	185	(146)
-interest free	35	297	(419)	19	176	(167)
-with interest	14	218	(189)	19	146	(83)

When expressed per consumption unit (cu), it appears that in 1988 16.2% of the household sample receive net cereal gifts surpassing 20 kg/cu compared to 7.4% in 1989. A similar pattern is observed for interest-free credit transactions: in 1988, 10.1% of households received cereal credits in excess of 20 kg/cu compared to 6.7% in 1989. In short, data imply that seasonal scarcity engenders more generalized reciprocity: cereal gifts increase in net frequency and value, as do interest-free credit transactions.

Data on the origins of cereal gifts and credit, however, suggests that households may attempt to limit the risk of non-return by contracting the valence of reciprocity to closer kin (Table 8.7). In 1988, the most frequently reported source of cereal gifts is patrikin (32.3%), followed by external agencies (32.2%), friends and neighbours (17.8%), and matrikin (12.9%). In the absense of food aid in 1989, cereal donors are confined to patrikin (37.0%), friends and neighbours (33.3%), and matrikin (26.0%).

As regards credit transfers, data from 1988 indicate that in times of scarcity Bèlèdugu households prefer to turn to friends, neighbours (37.5%), and patrikin (21.4%) for interest-free cereal credits over market traders (19.6%). In 1989, food bank schemes set up in the wake of the previous soudure account for the majority of credit transfers received (38.1%), followed by traders (19.0%) and patrikin (19.0%).

Table 8.7 Origins of Cereal Gifts and Credit During Soudure Seasons in 1988 and 1989 (% responses): 7 villages, Bèlèdugu, Mali

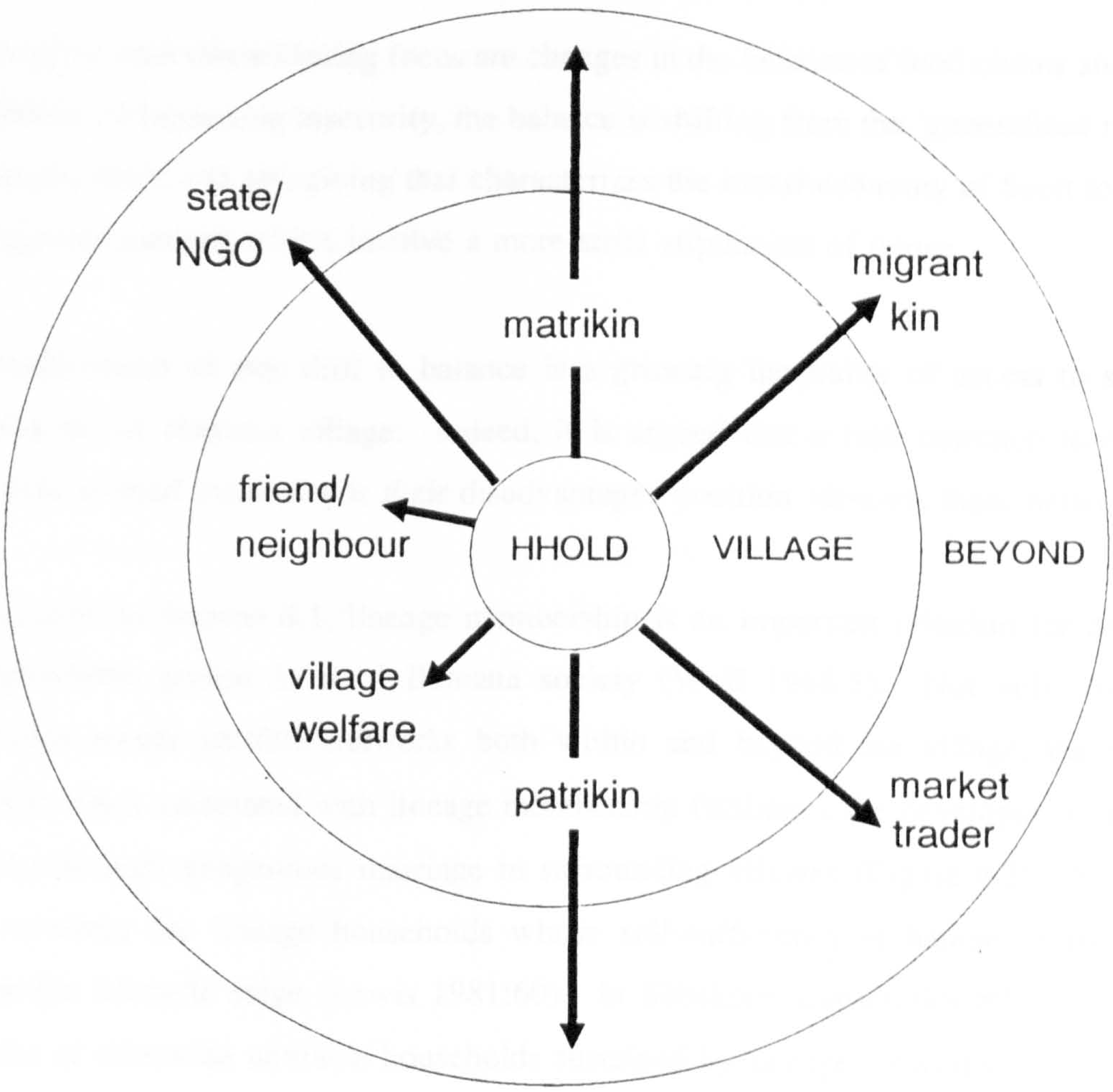
	GIFTS		CREDIT	
	1988 n=62	1989 n=27	1988 n=56	1989 n=42
DONOR				
patrikin	32.3	37.0	21.4	19.0
matrikin	12.9	26.0	7.1	9.5
friend/neighbour	17.8	33.3	37.5	14.3
trader	4.8	3.7	19.6	19.0
food aid/bank	32.2	---	14.3	38.1
ORIGIN				
village	11.3	37.0	51.8	54.8
nearby village	17.7	20.6	32.1	26.2
nearby centre	27.4	22.3	1.8	----
distant centre	33.9	3.7	14.3	19.0
another country	9.7	7.4	----	----

8.6 Spatial Context of Claims and Transfers

The preceding discussion has shown that in creating and maintaining social and economic relations between households, direct and indirect food claims and transfers function as a subsistence guarantee during periods of scarcity. This section will evaluate the importance of food claims and transfers to households most vulnerable to food insecurity. A spatial model presented in Figure 8.1 is used to situate the vulnerable in relation to the social and economic networks through which food claims and transfers operate.

In describing the moral economy in 19th century Hausaland, Watts has usefully conceptualized the normative subsistence guarantee as spreading through the peasant universe in "widening orbits of responsibility, from the household, to extended kin, to village patrons, and ultimately to the state itself" (Watts 1983:106-107). When applied to the context of the Bamana village, however, this model fails to engender the dynamic character of the contemporary peasant universe both in terms of the broadening focus of the 'subsistence guarantee' and the growing inequality of access to its different orbits of responsibility.

Figure 8.1 A Spatial Model of Subsistence Networks in the Bamana Village



Results from the Bèlèdugu suggest that social and economic networks in the Bamana village have diversified from the traditional kinship-based relations of pre-colonial society (Klaus 1976, N'Diaye 1970). Indeed, the volatility of cropping fortunes and need for money income have forced the farmer to diversify subsistence networks beyond proximate kin. Figuring in these broader networks are migrant kin in urban areas, dyadic associations with neighbours and friends, matrikin relationships with surrounding villages, and commodity relations with market traders.

Coterminous with this widening focus are changes in the balance of food claims and transfers. In a climate of increasing insecurity, the balance is shifting from the 'generalized reciprocity' of homage, alms, and gift-giving that characterizes the moral economy of Scott to credit and exchange transactions which involve a more strict stipulation of return.

One repercussion of this shift in balance is a growing inequality of access to subsistence networks in the Bamana village. Indeed, it is argued that a trait common to households vulnerable to food insecurity is their disadvantaged position vis-a-vis these networks.

As discussed in Section 8.1, lineage membership is an important criterion for demarcating socio-economic groups in rural Bamana society (Wolf 1966:5). Not only may lineage households access patrikin networks both within and beyond the village, the social and economic status associated with lineage membership facilitates the development of matrikin networks through exogamous marriage in surrounding villages (Figure 8.2). Sustained by these networks are lineage households whose self-sufficiency is hampered by illness or unfavorable lifecycle stage (Lewis 1981:60). In Sèbèkoro, households #205 and #220 are examples of otherwise unviable households sustained by lineage networks.

Households most vulnerable to food insecurity tend to be isolated from lineage networks. Asset poor, they are unable to cultivate economic networks with friends and neighbours nor can they invest in marriage relationships with lineage households (Swift 1989:13). Furthermore, given their marginalization from village power structures based on lineage membership, the vulnerable are frequently excluded from the distribution of state/NGO food aid or village food stocks accumulated through collective labour and project monies. In

Sèbèkoro, the ostracized lineage household #221 and household #s 226 and 229 were rarely included when such stock was distributed.

The isolation of food insecure households is further exacerbated by an inability or unwillingness to participate in communal labour arrangements. Because they tend to be small in size (Lewis 1981, Richards 1986, Toulmin 1986), the food insecure are less able divert scarce labour to communal work groups as the immediate cost to domestic agriculture is often perceived as greater than the benefits of later and less certain claims on communal labour. Even if free communal labour is available, few can afford to feed participating workers. Migrant networks may be less lucrative for similar reasons as the vulnerable can ill afford to release scarce labour resources from domestic production without jeopardizing the viability of the household (Toulmin 1986:61).

In the absence of networks whereby cereal might be procured as a loan or gift during periods of shortage, the food insecure are forced into volatile wage-labour and cereal markets. Even then, their relative poverty restricts access to loans and credit from market traders (Hill 1972). Subject to onerous interest rates and rainy season prices, they are compelled to repay cereal loans in cash or kind from harvest earnings. In Sèbèkoro, approximately one-half of farmers whose production was considered insufficient to meet domestic food needs were compelled to sell grain required for subsistence in order to cover tax, debt repayment and other social expenditures.

CHAPTER IX: CONCLUSIONS

9.0 Introduction

As a primary objective, this thesis defines the normative, nutritional and socio-economic character of food insecurity in the study region. Based on the investigation of indigenous conceptions of food security, a definition of household food security is developed which values the importance of a secure and sustainable food supply that is both culturally acceptable and sufficient to support the health and activity of household members. In keeping with this definition, households are stratified into three food security groups based on the degree to which they are able to sustain a normal and acceptable diet. As regards the nutritional character of seasonal food insecurity, the thesis investigates the relationship between seasonal fluctuations in food supply and variations in the nutritional risk of age and gender groups within the study population. The socio-economic character of food insecurity is explored by extending the analysis of nutritional risk to the household level where the production, distribution and consumption of food supply coincide.

Thus defined, as a secondary objective the thesis documents the widespread prevalence of seasonal food insecurity among agricultural households in the study region. Contrary to the impression that the region is largely self-sufficient in cereals on the basis of aggregate yields (Bulletin SAP 1986-90, Sundberg 1988), results indicate important intervillage differences in production outcomes. Further disaggregation to the household level reveals that less than 50% of households harvest sufficient millet to last the year. Among those households which run short of domestically produced cereal, between 40-60% are food insecure.

Even more striking are interannual variations in the prevalence of seasonal food insecurity. Comparing 1988 and 1989, the percentage of food secure households rose from 46 to 76%, while the percentage of food insecure households dropped from 53% in 1988 to 25% in 1989. Interannual variations in the severity of food insecurity are also noted; the percentage of severely food insecure households decreasing from 25% of the sample in 1988 to 14% in 1989.

While households have developed risk-minimizing strategies to cope with interseasonal fluctuations in food supply, the risk associated with stochastic interannual variations in food security is much greater and therefore more difficult to overcome without adverse consequence to household welfare. Successive years of food insecurity further amplify risk as residual effects such as a reduced asset base and indebtedness are inherited from the previous year.

As its final objective, the thesis considers the range of risk-minimizing strategies employed by agricultural households and their relative importance. A comparison of the quantitative contribution of these strategies to household food supply during soudure periods in 1988 and 1989, and the investigation of differences between stratified groups, illustrate how this repertoire of strategies is conditioned by exogenous factors and the endogenous characteristics of households.

By way of conclusion, this chapter examines the hypotheses articulated in Chapter I in light of study findings. Section 9.1 considers those which concern the impact of seasonal food insecurity on the nutritional risk of age and gender groups within the population, while Section 9.2 addresses those which relate to risk in the broader context of the household. In the last two sections, study results are discussed in terms of their implications for research (Section 9.3) and policy (Section 9.4).

9.1 Nutritional Risk of Age and Gender Groups

Two hypotheses are examined which concern the impact of seasonal food insecurity on nutritional risk of age and gender groups in the study population. In response to the first which asserts that seasonal nutritional risk is experienced differentially by age and gender groups within the sample population, significant seasonal variations in nutritional indicators are identified across the sample (Chapter IV). However, these seasonal changes are so small and transitory that it is reasonable to question the degree to which they represent nutritional risk in the particular year of study. Among children, fluctuations in anthropometric indices do not exceed the cut-off points established in Chapter IV, while in adults, lean tissue integrity is not compromised by seasonal variations in energy balance which mainly involve the mobilization of body fat.

Results also suggest that seasonal fluctuations in food supply are not the singular determinants of seasonal change in nutritional status. For example, strong correlations between nutritional indices and seasonal patterns of morbidity are found in children under five, while in adults, fluctuations in energy balance are more closely related to the seasonal energy demands of agricultural work. This argument is supported further by the absence of an absolute decline in household energy and protein intake relative to other seasons (Chapter V), and the lack of an association between household food insecurity and household-level age and gender indices of nutritional risk (Chapter VI). It appears that in addition to fluctuations in food supply, myriad other factors exacerbate seasonal nutritional risk ranging from environmentally caused variations in morbidity, to gender and/or seasonally-related activity, to genetically determined patterns of growth.

As regards the second hypothesis, study findings lend support to the view that the human organism is capable of adjusting to and recovering from mild seasonal variation in nutritional risk without apparent adverse consequence. In adults, body fat is mobilized to equilibrate elevated energy expenditure in the rainy season, and lean tissue preserved. The significantly greater loss of body weight among fatter individuals is a particularly 'adaptive' response, their basal energy requirements decreasing in reply to a season of heightened activity and food scarcity. Body fat is immediately reconstituted in the post-rainy season period as energy expenditure declines and household food security is restored with the new harvest. Among children, similar recovery is evident; low growth velocities during the rainy season are followed by accelerated 'catch-up' growth in the harvest and dry seasons.

Of course, these findings must be interpreted in the particular context of the year of study. More severe food insecurity might precipitate the deterioration of nutritional status beyond adaptive limits such that adverse functional impairment occurs, and differential age, gender and socio-economic effects become apparent. It is also difficult to surmise the longer-term consequences of mild to moderate seasonal variations in nutritional risk. For example, does cyclical growth velocity influence the later growth and development of children? To what extent is the high prevalence of 'Chronic Energy Deficiency' among post-reproductive women the long-term result of seasonal stress?

9.2 Nutritional Risk at the Household Level

Three hypotheses are entertained which relate to nutritional risk at the household level. The first posits the influence of exogenous factors and the endogenous characteristics of households on the range of strategies available to food insecure households, and therefore, the degree of nutritional risk they experience. Study findings indicate the primacy of rainfall in determining the prevalence of food insecurity throughout the region, however, the spacio-temporal variability of precipitation is such that some villages and/or households experience more severe food insecurity than others (Chapter VI).

The bio-geographic, economic and socio-cultural features of the village also affect the degree of food security risk that households experience. Villages located in lowland zones appear less vulnerable to the effects of rainfall deficiency, while those near market centres tend to be characterized by greater productive diversity which provides useful income when domestic cereal stocks run short. Indeed, access to cash through the sale of assets, labour and other remunerative activities represents the princip means of achieving food security in the face of production shortfall (Chapter VII). However, just as the market minimizes risk by providing a means of procuring cereal in the event of shortfall, the covariance of market prices and seasonal income works to exacerbate risk as households are forced onto the market when cereal prices peak, and purchasing power is compromised. The socio-cultural character of the village may also influence the prevalence and severity of seasonal food insecurity; 'traditional' villages tending to place greater emphasis on extended family agricultural production and communal networks of exchange which operate to minimize the risk of insecurity.

Modifying the impact of these exogenous factors are the endogenous demographic, socio-economic and allocative characteristics of households. When households are stratified according to risk of insecurity, among the endogenous characteristics most strongly associated with food security are indices of household wealth and productive strength (Chapter VI). In a labour limited agricultural environment, the large and wealthy household provides its members with an economy of scale which frees them to produce individual incomes as well as to accumulate capital as insurance substitutes (Binswanger and McIntire 1987).

Strong intercorrelations between household size, wealth indices and extensive kinship networks also suggest a greater capacity to invest in social networks of exchange which function as insurance substitutes in the event of food crisis. At the other extreme are poor, structurally disadvantaged households incapacitated by a small labour force, with limited productive assets and kinship support. Lacking both the productive strength to harvest sufficient cereal for domestic needs and the flexibility to diversify productive activity, they are forced to borrow, sell, and mortgage crops and assets, or more commonly, to divert household labour from domestic production to the labour market in order to meet the consumption needs of household members.

The second hypothesis asserts the continuing importance of social networks of exchange in minimizing the risk of food insecurity. Generally perceived to be weakening in the face of the market economy, Chapters VII and VIII demonstrate their continued vitality. Direct food transfers through cereal gifts and loans extended by kin, migrants and neighbours, or indirect transfers through labour networks or the loan of productive assets appear widespread and resilient regardless of the severity of shortage. Rather than wane in the shadow of the market and increasing climatic risk, the sphere of risk-pooling has spread outwards from proximate kin, to dyadic associations with neighbours and friends, to matrikin relationships with surrounding villages, to claims on migrant kin in urban centres. However, frequently marginalized from these networks are households at greatest risk of food insecurity.

The final hypothesis stresses the impact of seasonal food insecurity on the immediate and future viability of vulnerable households. The cost to domestic production implied by the search for food, the sale of productive assets, and the mortgaging of the current crop represent some of the immediate socio-economic consequences of household food insecurity. In the case of successive years of food insecurity, residual risk from the previous year may further erode household viability. According to study respondents, during drought periods in 1969-73 and 1984-85, the psychological stress and tension engendered by successive years of food insecurity and hunger provoked the dissolution of a large number of households.

9.3 Implications for Research

The field study employed a number of methodologies useful to future research concerning the food security and nutrition of agricultural communities. An interdisciplinary approach to data collection proved invaluable in better understanding the complex interactions between the many seasonal variables which impinge on the food security of rural households. Spanning the disciplinary boundaries of nutrition and the social sciences, the problem of seasonal food security challenges the investigator(s) to broaden the focus of research, and to integrate findings.

An interdisciplinary approach was facilitated by limiting the focus of the study to a single region where cross-sectional questionnaires were administered, and within this region, by confining in-depth investigation to a single village followed longitudinally over an annual cycle. The perspective of a larger village sample offers important insight into intervillage differences in the prevalence and severity of food insecurity, as well as a broader context for the interpretation of longitudinal findings. The longitudinal study provides an opportunity to place the problem of food insecurity within the rubric of rural life. In particular, insights are gained with respect to the dynamics of household behaviour and the complex social relations which operate to minimize the risk to some and to marginalize others. The derivation of variables from these qualitative observations permits an empirical investigation of their importance to food insecure households[1].

Like many questionnaire surveys, the first cross-sectional survey was flawed by questions that were too abstract or too pointed, inviting misinterpretation or deliberate falsification. Based on the experiences of the longitudinal study where much information was gleaned informally through dialogue and story-telling, the second cross-sectional survey attempted to avoid some of the weaknesses of a traditional questionnaire approach. Adapting the task of data collection to the cultural context, a dialogue approach was developed whereby informants were asked to describe their experience during a specific soudure season in story form using the agricultural calendar as a guide to the recollection of household strategies and consumption events (see Appendix I). Having surveyed the same households using both questionnaire and

[1] Indeed, the quantitative expression of qualitative data proved a useful approach to the integration of qualitative and quantitative data.

dialogue with respect to the soudure of 1988, the divergence of responses was noteworthy; perceptions of the severity of shortage being consistently greater with the questionnaire approach. This finding has important implications for the design of valid cross-sectional surveys.

In considering the nutritional consequences of seasonal food insecurity, a number of issues surrounding the question of "adaptation" are identified. Is the significant weight loss observed among adults in the rainy season a healthy response to increased energy expenditure or a reflection of dietary inadequacy and diminished agricultural productivity? The measurement of the composition of weight loss which indicates the mobilization of fat stores but the preservation of lean body mass suggests that these fluctuations may be adaptive, i.e. without functional consequence. Further research is needed to establish the limits of this adaptability, and the validity of the measures of change in lean and fat compartments as indicators of functional compromise. Likewise, the longer term consequences of seasonal fluctuation in growth and energy balance for children and women in particular need to be explored.

Research is also required on the adaptive capacity of the human organism with respect to seasonal variation in nutrient intake. Despite the evidence that the indigenous diet is well-balanced, seasonal variations in vitamin A, C, and Riboflavin are observed. Given the absence of manifest deficiency symptoms, is there sub-clinical vitamin deficiency? or have body stores adapted to accommodate seasonal deficiencies in intake without clinical significance?

At the community level, this thesis drew attention to the importance of indigenous institutions which minimize risk of food insecurity. Further research which draws on local knowledge and participation needs to be directed at better understanding the structure and function of existing institutions and strategies with a view to supporting and extending them to include marginal groups. The growing influence of the market economy and urban out-migration on the viability and food security of rural households also needs to be addressed.

9.4 Implications for Policy

Considering study results in view of the more practical needs of policy and action, a number of suggestions can be made. First, it appears that existing food security surveillance systems which rely on regional statistics such as aggregate rainfall, price and crop yields may not provide an accurate reflection of the prevalence or severity of the food security situation of monitored areas (Reardon et al. 1988). In the study region, large intervillage variations in the prevalence, severity and duration of seasonal food insecurity are observed. Because inter and intra-regional differences in climate, geography, the structure of production, market proximity and socio-cultural context are important in determining risk, they should be acknowledged when assessing relative needs in the case of relief assistance or development intervention. Disaggregated data on food insecurity by season, region, and further still to village and household levels, would assist in locating seasonal food insecurity and targeting those at extreme risk in need of immediate assistance.

While perhaps the best indicator of food insecurity, the measurement of household food consumption is too invasive and empirically demanding to be of use on a large scale. Furthermore, the lack of correlation between anthropometric indices and household food insecurity cautions against the assumption that measures of nutritional status and household food security are proxies of one another. While nutritional monitoring may provide an overall assessment of deprivation, inferences to the food situation of the household are far from straightforward. When attempting to explain seasonal variation in nutritional risk, study findings point to the influence of environmental, socio-cultural and other factors in addition to insufficient food supply. Results also caution against the extrapolation of nutritional risk in a particular age and/or gender group, to the status of the household as a whole, or *vice versa* (Chapter VI).

Given the limitations of conventional indicators in locating and predicting seasonal food insecurity, the monitoring of household coping strategies has been proposed as a useful component in early-warning systems (Campbell 1990, Davies et al. 1991). This view is premised on a model of household decision-making which presumes that households adopt strategies in a linear sequence depending on the severity of the food crisis they are experiencing. However, observations of the temporal character of household food security strategies in this study do not support this model. The combination and sequence of strategies pursued by the food insecure household is conditioned by its particular endogenous characteristics, exogenous constraints and a myriad of other intra and extra-household factors such that a general sequence of behaviour is not apparent. Simultaneous strategies are pursued at differing intensities depending on the timing of shortage, household preferences and circumstance. In short, the monitoring of food security strategies is unlikely to predict the prevalence or severity of food insecurity except in the case of last resort behaviour by which time the issue of prediction is irrelevant. For the purposes of prediction and prevention, this analysis suggests there may be greater value in trying to identify some of the endogenous characteristics which predispose households to greater food insecurity.

This is not to deny the value of investigating food security strategies. The study of household behaviour is essential to the task of policy response. This study points to the importance of a diversified productive base as a means of reducing risk in a region subject to unpredictable variations in rainfall and production sufficiency. For policy, this implies supporting diversification in terms of agriculture, e.g. crop choice, the exploitation of lowland and upland field types, and the use of animal traction in addition to the hand held hoe; and diversification in terms of productive activities, such as animal husbandry and non-farm income generation. Of course, it is imperative that these policies be sensitive to the seasonal demands of dryland agricultural environments. This involves understanding seasonal constraints to the adoption of new technologies and the need for counter-seasonal income-generation that does not interfere with agricultural production. In the case of women, the support of independent income generation such as market gardening may help to bridge season cereal shortfalls as well as to ensure a year-round supply of condiments. Their participation, however, is contingent on the introduction of technologies which reduce the time required for daily activities such as the pounding of millet and water collection. Adoption of female labour-reducing technologies may also have a beneficial influence on the health and nutrition of children, availing time and resources to their care.

The thesis also emphasizes the importance of non-market coping strategies used to minimize risk of seasonal insecurity. Evidence of social networks of exchange which range from labour sharing to cereal claims and transfers between neighbour and kin, to the cultivation of collective fields and the keeping of communal food security stocks are found throughout the study region. Indeed, the resilience of the moral economy is understandable given the limitations of both state and market to enhance the food security of rural agricultural areas in Mali. Perhaps greater attention should be paid to what agriculturalists can do for themselves? By recognizing and supporting their knowledge and participation, existing food security strategies and institutions might be strengthened and extended to include the vulnerable. Furthermore, the facilitation of indigenous efforts to design or strengthen their own credit organisations, income-generation opportunities, and collective food security schemes, is more likely to be a socially valued and effective means of enhancing food security in the long-term.

APPENDIX I: SURVEY QUESTIONNAIRES

1.0 First Cross-sectional Survey (October 1988): Household Questionnaire

SECTION I: INVENTAIRE DE LA CONCESSION

1.0 Enqueteur____________(__) 1.1 Village___________(__) 1.2 Menage (__ __ __) 1.3 Date (__ __-__ __-__ __)

1.4 Parente, occupation, etat de sante des personnes sur la concession:

nom et prenom	a no de sujet	b lien de parente	c sex	d age	e sante	f occupation 1iere	g 2ieme	h residence	i mange avec
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

SECTION II: ABSENCE DANS LE MENAGE

2.0 Precisez les membres de la concession qui sont absente aujourd'hui:

nom et prenom	a no de sujet	b date de departe	c destination	d motif	e activite	f duree	g frequence	h importance pour menage
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

SECTION III: SITUATION FAMILIALE

3.0 a) Depuis quand existe-t-il ce menage ? (__ __) 1 2

b) Precisez le village d'origine de toutes les femmes mariees du menage: (__ __) 3 4

i) nom/prenom de femme mariee ii) nom de village

c) Est-ce qu'il y a des membres de ce lineage (douba) qui se trouvent installer ailleurs ou dans ce village ? (__ __) 5 6

i) pre/nom de CM ii) liens de parente iii) nom de village

d) Est-ce qu'il y a les activites que tous les membres du lineage (douba) font ensemble ? Precisez:

i) les taches agricole ? (__ __) 7 8

ii) les fetes ? (__ __) 9 10

iii) d'autres activites ? (__ __) 11 12

3.1 Precisez les groupements villegeois dont font partis les membres du menage: (__ __) 13 14

i) prenom/nom ii) groupement(s)

SECTION IV: HISTOIRE DU MENAGE

4.0 a) A part des periodes de secheresse, vous rappellez-vous d'une period quand la production de nourriture du menage etait tres faible? (__ __) 1 2

Ouvrir une discussion: ______________________________ ...

b) Decrivez les periodes de secheresse et de penurie les plus graves dans l'histoire du menage: ______________________________ ... (__ __) 3 4

c) A part de la migration, quels sont les moyens utilizer dans le menage pour ce nourrir, pendant ces periodes difficiles ?

i) 1969-73 ?

hommes ______________________________ (__ __) 5 6

femmes ______________________________ (__ __) 7 8

enfants ______________________________ (__ __) 9 10

ii) 1983-84 ?

hommes ______________________________ (__ __) 11 12

femmes ______________________________ (__ __) 13 14

enfants ______________________________ (__ __) 15 16

iii) 1988 ?

hommes ______________________________ (__ __) 17 18

femmes ______________________________ (__ __) 19 20

enfants ______________________________ (__ __) 21 22

d) Est-ce que les strategies de lutte contre la penurie ont evolue avec le temps ? Comment ? (__ __) 23 24

____

SECTION V: PERCEPTIONS DE SECURITE D'ALIMENTATION

5.0 La securite du menage:

a) Quels sont les elements indispensible a l'autosuffisance d'une menage ?

Precisez pourquoi:

i) le plus importante: ______________________________ (__ __)
______________________________ 1 2

ii) le deuxieme importante: ______________________________ (__ __)
______________________________ 3 4

iii) les autres: ______________________________ (__ __)
______________________________ 5 6

5.1 La penurie:

a) Qu'est-ce que c'est "la Soudure" ? (__ __)
______________________________ 7 8
____

b) Dans quelle situation de votre grenier consideriez-vous la soudure ? (__)
9
____
____

c) Decrivez les conditions qui menent a "la penurie" (encercler):

1) manque de pluie (__) 10

2) manque de main d'oeuvre (__) 11

3) maladie des cultures (__) 12

4) predateurs (__) 13

5) manque de materiels agricoles (__) 14

6) trop de bouches a nourrir (__) 15

7) autres precisez (__) 16

d) Quels membres du menage sont les plus frappes par la penurie ? Pourquoi ? (__ __) 17 18

ex) les femmes, les hommes, les enfants, les ages:
____
____

e) Savez-vous des menages qui echappent a la penurie au village ici ? Si oui, comment ? (__ __) 19 20

____

____

f) Decrivez les consequences de la penurie: (__ __) 21 22

ex) pour la prochaine recolte, la sante, l'esprit familial ?

____

____

5.2 Les strategies contre la penurie:

a) Decrivez les moyens pris pour assurez une suffisance de nourriture pendant toute l'annee: (__ __) 23 24

____

____

b) En cas de penurie, ou est-ce que vous trouvez les moyens de procurer la nourriture?   (encercler les reponses)

1) entreaide villageois et familial (__) 25

2) activite(s) rapportant de l'argent (__) 26

3) vente de capitale e.g. betail (__) 27

4) remises familiales de l'exterieur (__) 28

5) chercher nourriture dans la brousse (__) 29

6) s'endetter (__) 30

7) cultivation de variete hatives (__) 31

8) voyager chez ses parents pour avoir de l'argent (__) 32

9) n'arrive pas a procurer la nourriture (__) 33

10) autre precisez (__) 34

c) Quelles sont les strategies au debut ? ____________________ (__ __) 35 36

____

d) Quelles sont les strategies en dernier ressort ? __________ (__ __) 37 38

____

e) Decrivez l'importance de l'entreaide villageois et de l'aide familiale en cas de penurie ? ____________________ (__ __) 39 40

____

SECTION VI: OBSERVATIONS DE LA CONCESSION

6.0 Les structures de la concession:

a) Nombre de structures (sans greniers)		(__ __) 1 2
b) Nombre en	i) bonnes condition	(__ __) 3 4
	ii) mauvaise condition	(__ __) 5 6
c) Materielle des portes: Nombre en	i) paille	(__ __) 7 8
	ii) bamboo	(__ __) 9 10
	iii) tole	(__ __) 11 12
	iv) bois	(__ __) 13 14
d) Materielle des toits: Nombre en	i) paille	(__ __) 15 16
	ii) tole	(__ __) 17 18
	iii) banco	(__ __) 19 20

6.1 Hygiene sur la concession:

a) Description de la cuisine:	encercler:	
i) case de cuisine ?	oui/non	(__) 21
ii) bien equipee ?	oui/non	(__) 22
iii) propre ?	oui/non	(__) 23
iv) ventilation ?	oui/non	(__) 24
b) Proprietaire d'une latrine ?	oui/non	(__) 25
c) Proprietaire d'une puit:	oui/non	(__) 26
i) moderne ?	oui/non	(__) 27
ii) traditionelle (couverte) ?	oui/non	(__) 28
iii) traditionelle (non-couverte) ?	oui/non	(__) 29

SECTION VII: MATERIELS DE LA CONCESSION

7.0 Materiels (encercler les reponses):

Etes-vous proprietaire de:

a) radio/cassette ?	(__)	1
b) mortier ?	(__)	2
c) bicyclette ?	(__)	3
d) mobylette ?	(__)	4
e) machine a coudre ?	(__)	5
f) charrue ?	(__)	6
g) charette ?	(__)	7
h) semoire ?	(__)	8

7.1 Betail (encercler les reponses):

Etes-vous proprietaire de:

a) bovins ?	(__)	9
b) boeuf de trait ?	(__)	10
c) caprins ?	(__)	11
d) poulets et pantardes ?	(__)	12
e) anes ?	(__)	13
f) ovins ?	(__)	14

SECTION VIII: STOCKAGE DE NOURRITURE

8.0 Precisez la capacite de la recolte pour nourrir le menage cette annee: (__) 1

1) pas de deficit
2) le fin de samiya (sept-oct)
3) au milieu de samiya (jui-aout)
4) jusqu'a sankunonji (mai-juin)
5) jusqu'a tilema (mars-avr)
6) le fin de fonene (jan-fev)
7) jusqu'a fonene (nov-fev)
8) pas de recolte

8.1 Est-ce que la recolte cette annee par rapport de l'annee passe est: (__) 2

1) plus grande
2) moins grande
3) la meme grandeur

8.2 a) Est-ce que le menage subissait les deficits de nourriture ? l'annee passe ? oui/non (__) 3

b) Si oui, quand: (__) 4
1) pas de deficit
2) le fin de samiya (sept-oct)
3) au milieu de samiya (jui-aout)
4) jusqu'a sankunonji (mai-juin)
5) jusqu'a tilema (mars-avr)
6) le fin de fonene (jan-fev)
7) jusqu'a fonene (nov-fev)
8) pas de recolte

8.3 Stockage des cultures:

a) Nombre de greniers ? (__ __) 5 6

b) Lieu de greniers ? (encercler les reponses): (__) 7

1) au champs
2) a la concession
3) autre precisez

c) Qualite des greniers (encercler les reponses): (__) 8

1) bonne condition en general
2) mauvaise condition en general
3) quelques uns sont bon
4) autre precisez

d) Fuites des stocks (encercler les reponses):

Problemes avec:
1) les predateurs ? (__) 9

2) les vols ? (__) 10

3) la moissure ? (__) 11

4) les oiseaux ? (__) 12

5) les seinges ? (__) 13

6) autre precisez ? (__) 14

1.1 First Cross-sectional Survey (October 1988): Village Questionnaire

SECTION I: SITUATION VILLAGEOIS

1.0 Enqueteur ________________ (__) 1

1.1 Village ________________ (__) 2

1.2 Population (__ __ __ __) 3 4 5 6

1.3 No. de menages (__ __ __ __) 7 8 9 10

SECTION II: DESCRIPTION DU VILLAGE

2.0 Situation des cases: (__) 1

Encercler le reponse:
1) entasser ?
2) etendue ?
3) autre precisez

2.1 Accessibilite:

a) distance d'une route principale (km) (__ __ __) 2 3 4

b) temps du village a la route pricipale:

	hr	min	
i) en vehicule ?	(__ __)	(__ __)	(__) 5
ii) par bicyclette ?	(__ __)	(__ __)	(__) 6
iii) a pieds ?	(__ __)	(__ __)	(__) 7

2.2 Formation sanitaires:

a) presence d'une centre de sante villageois ? oui/non (__) 8

i) si oui, decrivez le foncionnement: (__) 9

____

____

b) nombre des personnes medicale:

i) sages femmes traditionnelles (__ __) 10 11

ii) infirmiers/infirmieres (__ __) 12 13

iii) agents de sante villageois (__ __) 14 15

c) ou se trouve les centres de sante et les personnels medicales ?

	lieu (le plus proche)	km	
i) dispensaire/maternite	________________	(__ __ __)	(__) 16
ii) centre de sante villageois	________________	(__ __ __)	(__) 17
ii) pharmacies villagoeis	________________	(__ __ __)	(__) 18
iv) hopital	________________	(__ __ __)	(__) 19
v) sages femmes traditionelles	________________	(__ __ __)	(__) 20
vi) infirmier/infirmieres	________________	(__ __ __)	(__) 21
vii) agents de sante villageois	________________	(__ __ __)	(__) 22
viii) medicin	________________	(__ __ __)	(__) 23

2.3 Points d'eau:

a) points d'eau permanents:

i) nombre (__ __) 24 25

ii) emplacement (minutes a pieds) (__ __ __) (__) 26

iii) usage (encercler les reponses):

1) consommation ? (__) 27

2) abreuvement ? (__) 28

3) lessive ? (__) 29

b) points d'eau non-permanents:

i) nombre (__ __) 30 31

ii) emplacement (minutes a pieds) (__ __ __) (__) 32

iii) usage (encercler les reponses):

1) consommation (__) 33

2) abreuvement (__) 34

3) lessive (__) 35

c) nombres des puits:

nombre:

i) modernes? (__ __) 36 37

ii) traditionelle couverte ? (__ __) 38 39

iii) traditionelle non-couverte ? (__ __) 40 41

2.4 Formations scolaires:

a) formation scolaires au village ? oui/non (__) 42

b) nom de village/ville ou on trouve les formations scolaires:

	lieu (le plus proche)	km	
i) ecole primaire	____________	(__ __ __)	(__) 43
ii) ecole fondamentale	____________	(__ __ __)	(__) 44
iii) lycee	____________	(__ __ __)	(__) 45
iv) encadrement agricole	____________	(__ __ __)	(__) 46

2.5 Marche:

a) marche au village ? oui/non (__) 47

b) si oui, frequence hebdomataires (encercler): (__) 48

1) chaque jour de la semaine
2) 4-5 jours de la semaine
3) 2-3 jours de la semaine
4) un fois par semaine
5) autre precisez

c) si non, distance a pieds du marche la plus proche: min (__ __ __) 49 50 51

SECTION III: ORGANISATION DU VILLAGE

3.0 Nombre des quartiers au village: (__ __) 1 2

les noms: 1)____________ 5)____________
2)____________ 6)____________
3)____________ 7)____________
4)____________ 8)____________

3.1 Organisations sociales au village:

a) groupements des jeunes? oui/non (__) 3

Si oui:

1) nom de secretaire general: ____________

2) qui fait parti du groupe ? ____________ (__) 4

3) fonctionnement ? ____________ (__) 5

4) mode de payment ? ____________ (__) 6

b) associations de travail cooperatifs ? oui/non (___) 7

Si oui:

1) nom de secretaire general: ______________________

2) qui fait parti du groupe ? ______________________ (___) 8
____

3) fonctionnement ? ______________________________ (___) 9
____

4) mode de payment ? ______________________________ (___) 10
____

c) ton villageois ? oui/non (___) 11

Si oui:

1) nom de secretaire general: ______________________

2) qui fait parti du groupe ? ______________________ (___) 12
____

3) fonctionnement ? ______________________________ (___) 13
____

4) mode de payment ? ______________________________ (___) 14
____

d) associations des femmes ? oui/non (___) 15

Si oui:

1) nom de secretaire general: ______________________

2) qui fait parti du groupe ? ______________________ (___) 16
____

3) fonctionnement ? ______________________________ (___) 17
____

4) mode de payment ? ______________________________ (___) 18
____

e) associations religieuses ? oui/non (___) 19

Si oui:

1) nom de secretaire general: ______________________

2) qui fait parti du groupe ? ______________________ (___) 20
____

3) fonctionnement ? ______________________________ (___) 21
____

4) mode de payment ? ______________________________ (___) 22
____

3.2 Assistance pour les ages, les pauvres et les infirmes:

a) formes entreaide villageois? (___) 23

____

____

b) formes entreaide au niveau du menage/de la individuelle ? (___) 24

____

____

3.3 Systeme de travail agricole:

a) decrivez les taches agricole faisant par les femmes: (___) 25

____

____

b) decrivez les taches agricole faisant par les hommes: (___) 26

____

____

c) a quel age est-ce qu'on commence le travail agricole:

filles ? _______________ (___) 27

garcons ? _______________ (___) 28

d) a quel age ou dans quelles conditions est-ce qu'on prende la retrait ? (___) 29

____

SECTION IV: HISTOIRE DU VILLAGE

4.0 Decrivez la date ou l'epoque historique de la creation du village: (___) 1

Encercler le reponse:
1) bien avant que les Francais soient arrives ? (t.ancien)
2) a l'epoque que les Francais sont arrives ? (ancien)
3) aux allentours de la secheresse de 1935 ? (recente)
4) aux allentours de l'independence ? (t.recente)

4.1 Precisez le lineage fondatateur, et l'ordre d'arriver de autres lineages familiales: (___) 2

1) _______________	7) _______________
2) _______________	8) _______________
3) _______________	9) _______________
4) _______________	10) _______________
5) _______________	11) _______________
6) _______________	12) _______________

4.2 Si il ya un marche, depuis quand existe-t-il ? ____________________ (__) 3

4.3 Decrivez les periodes de secheresses et penurie les plus graves au village depuis sa creation: ____________________ (__) 4

4.4 Quels etaient les moyens pris pour procurer la nourriture pendant ces periodes de secheresse et penuries dans l'histoire du village ? ____________________ (__ __) 5 6

4.5 Decrivez les changements au village depuis l'independence ?

par exemple:

a) la migration ? ____________________ (__) 7

b) les pluies ? ____________________ (__) 8

c) grandeur des menages ? ____________________ (__) 9

d) les habitudes villageois ? ____________________ (__) 10

e) changements d'alimentation ? ____________________ (__) 11

f) penurie de nourriture ? ____________________ (__) 12

g) nombres d'enfants ? ____________________ (__) 13

h) les maladies ? ____________________ (__) 14

i) les attitudes des jeunes ? ____________________ (__) 15

j) autres changements ? ____________________ (__) 16

1.3 Second Cross-sectional Survey (November 1989): Household Questionnaire

SECTION I: PRODUCTION

1.0 Enqueteur ______________(__ 1) 1.1 Village ______________(__ 2)

1.2 Menage __ 3 __ 4 __ 5 1.3 Nom de sujet ______________(__ 6 __ 7 __ 8 __ 9 __ 10 __ 11)

1.3 Production de l'hivernage 1988

a) A-t-elle (la production) ete suffisante jusqu'a maintenant?

Encercler: OUI NON

b) Pourquoi a-t-elle ete suffisante/insuffisante?

____
____
____
____

c) Si la production n'etait pas suffisante, qu'avez vous fait en ce moment pour nourrir le menage?

Remplir: Section 2.0

1.3 Production de l'hivernage 1987

a) A-t-elle (la production) ete suffisante jusqu'a la recolte de 1988?

Encercler: OUI NON

b) Pourquoi a-t-elle ete suffisante/insuffisante?

____
____
____
____

c) Si la production n'etait pas suffisante, qu'avez vous fait en ce moment pour nourrir le menage?

Remplir: Section 2.1

SECTION II: DIALOGUE CONCERNANT LA CONSOMMATION PENDANT LA SOUDURE

2.0 Decrivez la consommation pendant la soudure cette annee:

____...

2.1 Decrivez la consommation pendant la soudure l'annee passe:

____...

IN THE DIALOGUE THE INTERVIEWER IS CAREFUL TO NOTE THE FOLLOWING CONSUMPTION EVENTS, THEIR TIMING AND DURATION:

1) point at which granary is empty
2) periods in which rationing occurs
3) periods in which the number of meals are reduced
4) changes in meal preparations ie) brouille, millet bran, wild leaves and millet mixed, wild leaves/ronier only
5) prepare for children only
6) nothing prepared
7) millet credit
8) millet gifts
9) millet purchases
10) food aid

THE DIALOGUE BETWEEN INFORMANT AND INTERVIEWER FOLLOWS THE CHRONOLOGY OF THE AGRICULTURAL CALENDAR:

clear/cultivate →	seed →		→	→	1st weed →		→	2nd weed →		→	maize/premat mil →			early mil harv →			main harv
early JUNE	mid	late	early JULY	mid	late	early AUGUST	mid	late	early SEPTEMBER	mid	late	early OCTOBER	mid	late	early NOVEMBER	mid	late	early* DECEMBER

*the approximate timing of agricultural events re) the western calendar during the years of study

FOLLOWING THE SEMI-STRUCTURED DIALOGUE, INTERVIEWERS REQUEST DETAILS OF CITED STRATEGIES:

SECTION III: LES STRATEGIES PENDANT LA SOUDURE CETTE ANNEE/L'ANNEE PASSE

3.0 Main d'oeuvre

qui	# sujet	activites	lieux	remuneration	consequences

3.1 Cadeaux

a qui	# sujet	de qui	origine	nature	consequences

3.2 Endettement

qui	# sujet	avec qui	lieux	nature	consequences

3.3 Ceuillette

qui	# sujet	lieux	nature	consommation	consequences

3.4 Activites remuneratrices

qui	# sujet	activite	remuneration	utilisation	consequences

3.5 Vente

qui	# sujet	nature	revenus	utilisation	consequences

3.6 Migration

qui	# sujet	activite	lieux	depart/duree	revenus	utilisation	consequences

SECTION IV: LES MALADIES/LES DECES PENDANT LA SOUDURE

4.0 Deces

qui	#sujet (lien/sex/age)	moment	symptomes	cause

4.1 Maladies

qui	#sujet	moment	symptomes	cause

GUIDE POUR SECTION III: LES STRATEGIES PENDANT LA SOUDURE

3.0 Main d'oeuvre

qui	# sujet	activites	lieux	remuneration	consequences
prenom/nom #sujet ou mettre details sur l'inventaire		piler trav domestique trav agricole pous-pous	le village village proche village loin Kolokani/Kayes/ BKO/d'autres regions/pays	l'argent (CFA tot) mil (kg tot) son emprunt materiels main d'oeuvre	pour la production ie) dim. de surface cultiver/changement de culture economique/sociale/ nutritionelle/sante

3.1 Cadeaux

a qui	# sujet	de qui	origine	nature	consequences
prenom/nom #sujet ou mettre details sur l'inventaire		parente proche/ loin precisez beaux parents ami(e) commercant	le village village proche village loin Kolokani/Kaye/ BKO/ d'autre regions/pays	l'argent (CFA tot) mil (kg tot) son dons de materiel/ betails precisez	production economique /sociale/ nutritionelle/sante

3.2 Endettement

qui	# sujet	avec qui	lieux	nature	consequences
meme chose		meme chose	meme chose	meme chose	meme chose

3.3 Ceuillette

qui	# sujet	lieux	nature	consommation	consequences
meme chose		proche ou loin ie) 2jrs de marche	racine/feuille et nom Bamana	decrivez preparation	meme chose

3.4 Activites renumeratrices

qui	# sujet	activite	revenus	utilisation	consequences
meme chose		vente:cola/lait condiments/bois l'herbe/tissage/ forge/chasse/ fetish/guerisseur/	l'argent (CFA tot estimation mil (kg tot)	achats de mil/ materiels/mains d'oeuvre	meme chose

3.5 Vente

qui	# sujet	nature	revenus	utilisation	consequences
meme chose		l'or/boeuf/ vache/ cheval/ mouton/chevres/ material/velo etc precisez quantite	l'argent (CFA) mil (kg tot)	meme chose	meme chose

3.6 Migration

qui	# sujet	activite	lieux	depart/duree	revenus	utilization	consequences
meme chose		voir main d'oeuvre		saison/annee de depart et duree	l'argent/ mil/habits materials envoyer	si l'argent qu'ont ils fait avec avec l'envoie	meme chose

GUIDE POUR SECTION IV: LES MALADIES/LES DECES PENDANT LA SOUDURE

a) Deces

qui	#sujet (lien/sex/age)	moment	symptomes	cause
meme chose		situer avec calendrier agricole	odeme/mal au ventre/ fievre/	consommation des feuille toxiques/ la faim

b) Maladies

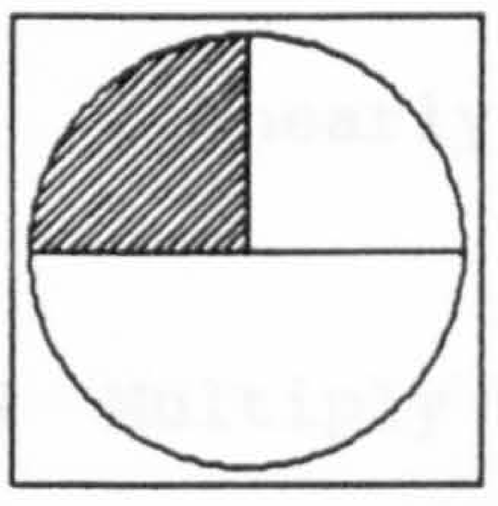
qui	#sujet	moment	symptomes	cause
meme chose		meme chose	meme chose	meme chose

APPENDIX II: CALCULATING GRANARY STORES

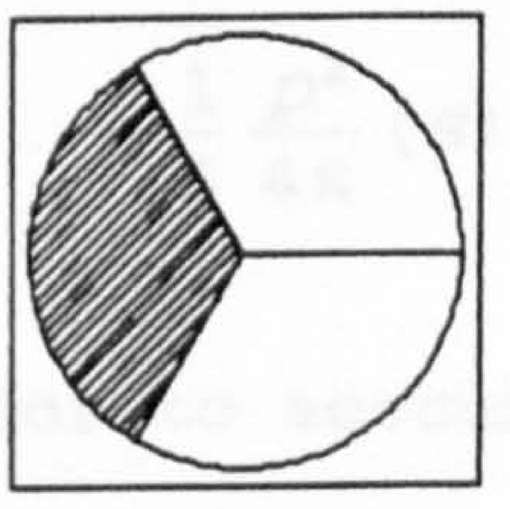
(Robert Leland 1989)

2.0 Note and sketch granary type:

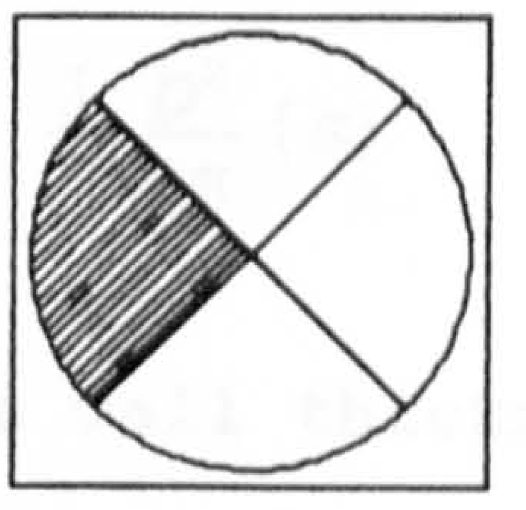
top view:



TYPE A



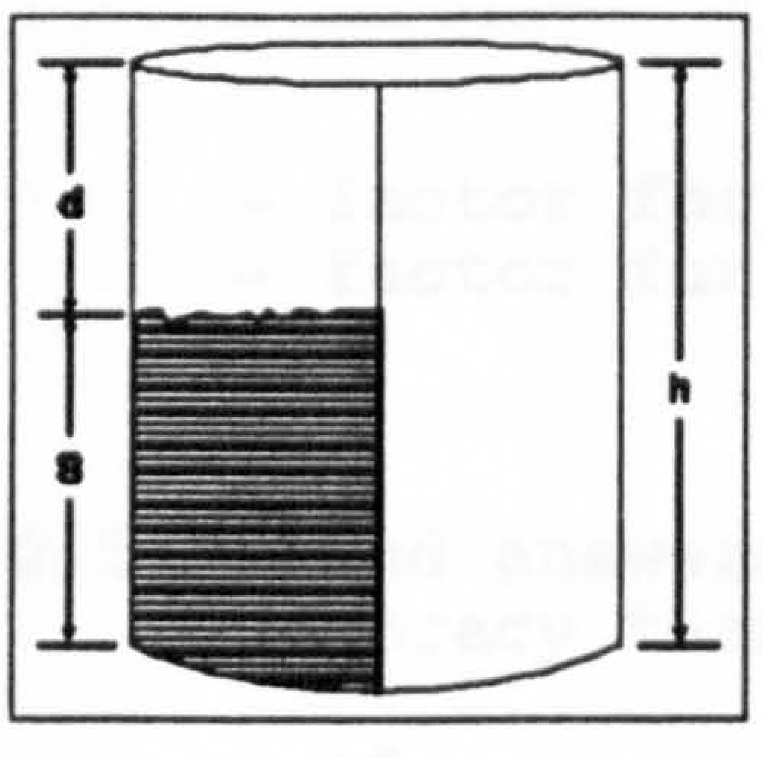
TYPE B



TYPE C

2.1 With measuring rope (knotted every metre) and ruler, measure the following to the nearest centimetre:

side view:



P = outside perimetre of granary

h = height of granary

d = depth from top to grain if substantially filled

or

s = actual height of grain if nearly empty

P is measured with the rope at the same level with mild tension applied

h is measured from the top of exterior mud wall to bottom. The thickness of the base has been accounted for in the formulas.

d is found by tying a stone to end of the rope at one knot and suspending it to the surface of the grain which should be smoothed out until level

s is found by sticking the metal ruler in the grain until it touches the compartment floor

2.2 Calculate compartment volumes using:

type	A	B	C
compartment volume	$\frac{1}{4}\frac{p^2}{4\pi}(h-d)$	$\frac{1}{3}\frac{p^2}{4\pi}(h-d)$	$\frac{p^2}{4\pi}(h-d)$
if nearly empty	$\frac{1}{4}\frac{p^2}{4\pi}(s)$	$\frac{1}{3}\frac{p^2}{4\pi}(s)$	$\frac{p^2}{4\pi}(s)$

2.3 Multiply by a factor to account for the wall thickness

type	A	B	C
compartment error factor	.85	.75	.75

2.4 Convert the compartment volume to weight by multiplying:

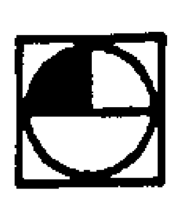
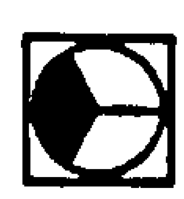
$$\frac{\text{weight in kg of known volume of grain}}{\text{Volume of known volume in } m^3}$$

- factor for millet 889 kg/m^3
- factor for groundnut 337 kg/m^3

2.5 Round answers to 2 significant figure to avoid claiming more accuracy than warranted:

- if answer < 10, round to first decimal point
- if answer > 10, round to nearest whole number

THE FORMULAS SIMPLIFY TO:

type	A 	B 	C 
compartment volume	$\frac{p^2}{59.2}(h-d)$	$\frac{p^2}{50.2}(h-d)$	$\frac{p^2}{67.0}(h-d)$
if nearly empty	$\frac{p^2}{59.2}(s)$	$\frac{p^2}{50.2}(s)$	$\frac{p^2}{67.0}(s)$

for other granary types, use the following formula:

$$\text{Volume} = \left(\frac{3}{4}\right)\cdot\frac{p^2}{4\pi}(h-d)\cdot()$$

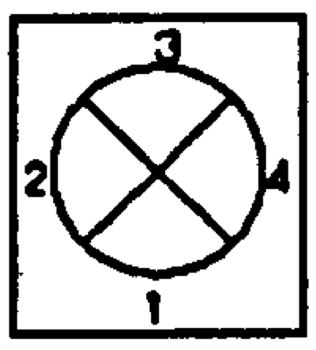
↑
estimate of fractional volume of compartment

SAMPLE DATA SET:

household 220

$p = 9.38$ m

$h = 1.71$
$\quad\; 1.73$
$\quad\; 1.68$
$\quad\; \text{-----}$
$\quad\; 5.12 \;/3 = \text{mean} = 1.71$ m

household	sketch	compartment	grain	d	s	V	W
220		1	--	--	--	--	--
		2	millet	1.14	--	.75	670
		3	--	--	--	--	--
		4	groundnut	--	.05	.07	22

compartment 2:

TYPE C

$$V=\frac{p^2}{67.0}(h-d)=\frac{9.38^2}{67.0}(1.171-1.14)=0.7484m^3$$

$$W=(.7485m^3)(889kg/m^3)=665.4kg\rightarrow 670kg$$

compartment 4:

TYPE C

$$V=\frac{p^2}{67.0}(s)=\frac{9.38^2}{67.0}(0.05)=0.06566m^3$$

$$W=(0.6566m^3)(337kg/m^3)=22.13kg\rightarrow 22kg$$

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

FOOD	FOOD CODE[1]	ENERGY (kcal)	PROTEIN (g)	FAT (g)	CARBO-HYDRATE (g)	CALCIUM (mg)	IRON (mg)	VITAMIN A (μg)[2]	THIAMINE (B1) (mg)	RIBOFLAVIN (B2) (mg)	NIACIN (mg)	VITAMIN C (mg)	FOLIC ACID (μg)	SOURCE (end-notes)
GRAINS														
Mil, Graine (*sanyo*)	1	340	10.0	4.0	70.0	22	21.0	4.2	0.30	0.22	1.70	3		2
Sorgho, Graine (*keninge*)	2	342	9.8	3.2	74.0	40	5.8	3.3	0.34	0.15	3.30	0		1, 2
Maïs, Graine (*kaba*)	3	364	10.0	4.8	73.6	13	4.9	16.7	0.32	0.12	1.70	4		1
Maïs, Farine	4	368	9.4	3.3	74.1	18	3.3		0.26	0.08	1.00			1
Maïs, Epi, Grillé	5	381	8.0	4.8	79.2	2	3.0	0.0	0.02	0.09	2.20			1
Riz, Décortiqué (*malo*)	6	362	6.8	0.5	81.1	11	1.8	0.0	0.12	0.03	2.70	0		1
Riz, Paddy	7	353	6.2	2.0	76.4	27	7.6		0.34	0.05	5.80			1
Fonio, Paddy (*fini*)	8	332	7.1	3.0	74.4	41	8.5		0.24	0.10	1.90			1
Fonio, Decortiqué	9	349	7.4	1.2	78.7	26	3.4		0.16	0.10	2.00			1
Mil, Couscous/*dègè*, Sec	10	227	5.7	1.0	52.4	19	5.0	trace[3]	0.20	0.06	0.80	0		1
Sorgho, Farine	11	335	9.5	2.8	73.0	28	10.0	3.3	0.28	0.09	3.40	0		2
Sons de Mil (*bu*)	13	325	11.0	7.6	53.4	80	41.0		1.01					1
Pain (*nburu*)	15	240	7.7	2.0	51.0	37	1.7	0.0	0.16	0.06	1.00	0	28	2
Macaroni, Cru	16	369	12.5	1.2	75.2	27	1.3	0.0	0.09	0.06	1.70	0		6
Farine de Blé (*alikama*)	17	340	11.0	2.0	74.0	36	3.6	0.0	0.37	0.08	2.80	0	51	2
Sorgho, Segere	260	238	6.3	1.5	48.6	10	4.0	trace	0.26	0.06	2.10	0		1
Sons de Sorgho, Poudre	261	341	15.4	4.7	65.1									1
Mais, Couscous Sec	262	368	7.8	3.2	75.5	7	5.0	7.5	0.20	0.08	1.80	0		1
Mil, Farine	265	335	5.9	3.5	71.0	17	39.0		0.18	0.22	1.00			2
Macaroni, Bouilli	268	110	3.4	0.4	23.0	8	0.9	0.0	0.14	0.08	1.30	0	3	2

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

FOOD	FOOD CODE[1]	ENERGY (kcal)	PROTEIN (g)	FAT (g)	CARBO-HYDRATE (g)	CALCIUM (mg)	IRON (mg)	VITAMIN A (μg)[2]	THIAMINE (B1) (mg)	RIBOFLAVIN (B2) (mg)	NIACIN (mg)	VITAMIN C (mg)	FOLIC ACID (μg)	SOURCE (end-notes)
ROOTS AND TUBERS														
Manioc (*bananku*)	20	149	1.2	0.2	35.7	68	1.9	5.0	0.04	0.05	0.60	31		1
Pomme de Terre	21	75	1.7	0.1	18.0	13	1.1	6.3	0.07	0.03	1.30	21	14	2
Igname (*kù*)	22	110	1.9	0.2	27.0	52	0.8	4.2	0.11	0.02	0.30	6		2
Igname Sauvage (*niana*)	139	124	3.2	0.1	28.3	52								1
Patate Douce (*woso*)	23	110	1.6	0.2	28.0	33	2.0	300.0	0.09	0.04	0.70	37	52	2
LEGUMES, NUTS, AND SEEDS														
Arachide, Sèche, Décortiquée (*tiga*)	31	549	23.2	44.8	23.0	49	3.8	2.5	0.79	0.14	15.50	1		1
Pâte D'Arachide	32	555	25.0	47.2	18.0	61	6.0		0.39	0.13	15.00	0		1, 7
Haricôt (*shyò*), Graine	33	342	23.1	1.4	61.4	101	7.6	11.7	0.75	0.18	2.50	1		1
Pois De Terre, Graine (*tiganinkurun*)	35	345	19.0	6.2	57.0	62	12.0	1.7	0.47	0.14	1.80	0		2
Arachide, Crue, Décortiquée	36	303	15.0	19.4		56	2.1	3.0				11		8
Da kumu, Graine	77	427	20.2	19.6	47.5	294								1
Datu, Poudre	67	415	21.4	20.3	41.9	320			0.17					1
Soumbala, Boule	68	432	36.5	28.8	15.8	378	36.5		0.04	0.61	1.90	2		1
Soumbala, Poudre	69	431	32.8	26.4	23.6	278	33.0		0.04		2.10	0		1
MEAT AND FISH														
Boeuf, Frais (*misisogo*)	40	235	18.0	18.0	0.0	11	3.6	24.8	0.26	0.15	4.00	0	7	2
Boeuf, Grillé	41	284	21.8	9.9	0.0	12	4.0	37.0						10
Mouton, Frais (*sagasogo*)	42	255	17.0	21.0	0.0	10	2.0	10.0	0.12	0.17	3.10			2
Chèvre, Frais	43	170	18.0	11.0	0.0	11	2.3	0.0	0.17	0.32	5.60			2

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

FOOD	FOOD CODE[1]	ENERGY (kcal)	PROTEIN (g)	FAT (g)	CARBO-HYDRATE (g)	CALCIUM (mg)	IRON (mg)	VITAMIN A (μg)[2]	THIAMINE (B1) (mg)	RIBOFLAVIN (B2) (mg)	NIACIN (mg)	VITAMIN C (mg)	FOLIC ACID (μg)	SOURCE (end-notes)
Poulet (*shiwalan*)	44	140	20.0	6.5	0.0	10	1.1	85.0	0.10	0.15	3.70	0		2
Oeuf, Poule (*shifan*)	47	140	12.0	10.0	1.0	45	2.0	400.0	0.10	0.30	0.30	0	25	2
Oeuf, Pintade	48	150	11.5	10.6		43	3.6	470.0						8
Tilapia, Grillé (*tinbin*)	49	524	39.4	39.4	0.0	5051								1
Silure, Sec (*manògò*)	51	324	62.5	6.3	0.0	1370	3.6							1
Tilapia, Sec	53	334	54.3	11.3	0.0	2406	10.4		0.08	0.61	5.80			1
Carpe, Sèche et Fumé	54	351	79.2	1.4	0.0									1
Lapin en Ragoût	55	216	29.3	10.1	0.0	21	1.5		0.05	0.07	11.30			6
Chèvre, Grillé (*basogo*)	57	216	19.0	13.6	0.0	12	2.4							10
Tineni, Sec	58	399	77.7	7.5	0.0	1070	5.1							1
Poisson Chien	231	383	73.5	7.7	0.0	500	21.6							1
Tête de Mouton ou Chèvre, Bouillie	234	119	12.8	7.1		7								9
Poisson Sec, Divers Espèces (*jègè*)	235	269	47.3	7.4	0.0	1018	4.9		0.07	0.33	6.20	0		1
Poisson Frais, Divers Espèces	244	115	22.2	3.0	0.0	32	1.7		0.05	0.08	2.80	0		1
VEGETABLES														
Gombo, Frais (*gan*)	60	36	2.1	0.2	8.2	84	1.2	30.8	0.04	0.08	0.60	47	23	1, 8
Gombo, Poudre	61	282	10.7	0.8	69.7	968	36.4	28.3	0.26	0.43	4.60	10		1
Oignon, Fraiche (*jaba*)	62	38	1.2	0.1	9.0	27	0.8	0.0	0.02	0.04	0.20	11	14	1, 2
Oignon, Poudre	63	266	11.2	1.4	82.1	210	7.0		0.25	0.18	1.40	63		6, 8
Tomate, Fraiche (*tamati*)	64	22	1.0	0.2	4.0	10	0.6	85.8	0.06	0.04	0.60	26	28	1, 2
Tomate, Concentré	65	84	3.8	0.9	18.8	35	3.0	247.0	0.16	0.19	3.20	42		3

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

FOOD	FOOD CODE[1]	ENERGY (kcal)	PROTEIN (g)	FAT (g)	CARBO-HYDRATE (g)	CALCIUM (mg)	IRON (mg)	VITAMIN A (μg)[2]	THIAMINE (B1) (mg)	RIBOFLAVIN (B2) (mg)	NIACIN (mg)	VITAMIN C (mg)	FOLIC ACID (μg)	SOURCE (end-notes)
Piment, Frais (*foroton*)	70	94	4.1	2.3	18.0	58	2.9	1190.0	0.25	0.20	2.40	121		1
Piment, Sec	71	346	12.5	11.5	61.5	187	16.7	2375.0	0.38	0.68	7.20	12		1
Ail, Fraiche	73	131	5.2	0.1	30.2	33	1.7					11		1
Chou	74	26	1.7	0.1	6.0	47	0.7	16.7	0.04	0.04	0.30	54		1
Gombo, Sec, Tranche	75	283	10.8	1.2	69.1	825	26.3	9.2	0.63	0.81	5.50	20		1
Da, Feuille, Fraiche	76	67	5.5	1.2	12.2	484	12.1					75		1
Baobab, Feuille, Fraiche (*nsirabulu*)	78	67	3.8	0.3	13.0	400	1.1					52		1, 2
Aubergine Indigène Fraiche (*nkòyò*)	86	40	1.4	1.0	8.0	21	0.9	0.5				8		1, 10
Baobab, Feuille, Seche	89	282	12.3	3.1	63.2	2241	24.0	1618.3	0.13	0.82	4.40	trace		1
Aubergine, Feuille, Fraiche	220	42	4.6	1.0	6.4	391								1
Haricot, Feuille, Frais	221	44	4.7	0.3	8.3	256	5.7	1328.3	0.20	0.37	2.10	56		1
Arachide, Feuille, Fraiche	222	69	4.4	0.6	14.9	262	4.2	1289.2	0.23	0.58	1.60	98		1
Oignon, Feuille, Fraiche	226	22	1.3	0.1	4.9	90						17		1
Courge (*je*)	227	23	1.0	0.1	5.5	25	1.4	383.3	0.05	0.02	0.50	8	8	1, 2
Gombo, Feuille, Fraiche	228	56	4.4	0.6	11.3	532	0.7	121.7	0.25	2.80	0.20	59		1, 2
Salade (*salati*)	229	20	1.2	0.2	4.0	26	0.7	325.0	0.06	0.15	0.40	10	89	2
Haricôt, Feuille, Seche	280	277	22.6	3.2	54.6	1556	12.0					86		1
Aubergine (*tubabunkòyò*)	281	30	1.0	0.2	7.7	14	1.3	8.5	0.05	0.05	0.50	9	29	1, 2
Da, Feuille, Seche	282	258	21.0	1.3	54.9	1030	16.0							1
Feuille, Fraiche, Verte Claire	283	26	1.7	0.1	5.0	47	0.7	20.8	0.04	0.04	0.30	54	79	2

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

FOOD	FOOD CODE[1]	ENERGY (kcal)	PROTEIN (g)	FAT (g)	CARBO-HYDRATE (g)	CALCIUM (mg)	IRON (mg)	VITAMIN A (μg)[2]	THIAMINE (B1) (mg)	RIBOFLAVIN (B2) (mg)	NIACIN (mg)	VITAMIN C (mg)	FOLIC ACID (μg)	SOURCE (end-notes)
Feuille, Fraiche, Verte Moyenne	284	25	1.8	0.2	4.0	76	1.8	375.0	0.04	0.16	0.70	41	50	2
Feuille, Fraiche, Verte Foncée	285	58	4.5	0.3	10.0	360	7.2	550.0	0.15	0.53	1.20	80	105	2
FRUITS														
Mangue (*mangaro*)	90	60	0.6	0.2	15.0	24	1.2	400.0	0.03	0.05	0.40	42	7	2
Banane (*namasa*)	91	82	1.5	0.1	20.0	9	1.4	25.0	0.03	0.03	0.60	9	19	2
Tamarin (*n'tomi*)	92	68	2.0	0.2	16.6	60						8		1
Orange (*lenburuba*)	95	44	0.6	0.4	10.0	28	0.1	121.7	0.02	0.03	0.20	46	37	2
Parinari Excelas (*zaban*)	96	71	0.8	0.2	18.5	51	1.0	trace	0.15	0.03	0.50	48		1
Rhônier (*sèbè*)	98	43	0.8	0.1	10.9	27	1.0	trace	0.04	0.02	0.30	5		1
Coco	99	388	3.6	39.0	13.8	21	2.5	4.2	0.03	0.03	0.60	2		1
Nèrè, Pulpe	101	303	3.4	0.4	80.1	124	3.6	405.0	1.05	0.71	1.00	242		1
Palmier à Huile (*nten*)	104	540	1.9	58.4	12.5	82	4.5	10,000	0.20	0.10	1.40	12		1
Détar (*tamanogo/taba*)	105	116	1.9	0.4	29.6	27	2.8	27.5	0.14	0.05	0.60	1290		1
Cordyla (*dukura*)	106	70	1.4	0.1	17.8	29	1.8	51.7	0.02		0.80	74		1
Papaye (*manji*)	108	30	0.4	0.1	7.0	21	0.6	50.0	0.03	0.03	0.04	52	1	2
Jujube (*n'tombolo*)	109	240	3.7	0.1	63.0	170	3.1	0.0	0.02		2.10	35		1
Citron (*lenburu kumunin*)	111	32	0.6	0.8	8.7	19	0.7	1.7	0.03	0.02	0.30	45		1
Goyave (*buyaki*)	112	46	1.1	0.4	10.0	24	1.3	60.8	0.06	0.04	1.30	325	7	2
Pomme	113	58	0.2	0.4	15.1	3	0.2	13.3				1		1
Pastèque (*nsàre*)	116	22	0.5	0.1	5.5	8	0.3	52.5	0.04	0.05	0.10	8	3	1, 2

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

FOOD	FOOD CODE[1]	ENERGY (kcal)	PROTEIN (g)	FAT (g)	CARBO-HYDRATE (g)	CALCIUM (mg)	IRON (mg)	VITAMIN A (μg)[2]	THIAMINE (B1) (mg)	RIBOFLAVIN (B2) (mg)	NIACIN (mg)	VITAMIN C (mg)	FOLIC ACID (μg)	SOURCE (end-notes)
Jujube, Sèche	117	287	4.3	0.1	75.4	210	3.0		0.03	0.02	2.10	24		1
Karité, Pulpe (*si*)	118	94	1.9	1.2	21.7		4.7	0.0	0.02	0.03	1.00	1		1
Kaki de Brousse (*sunsun*)	119	125	1.0	trace	33.9	42	2.0		0.01		0.20	13		1
Datte (*ntamaro*)	187	295	2.7	0.6	74.0	82	9.4	37.0	0.06	0.15	1.80	O	20	2
Baobab, Pulpe (*nsira*)	225	290	2.2	0.8	76.7	284	7.4	16.3	0.37	0.06	2.10	270		1, 2
MILK (*nònò*)														
Lait De Vache, Frais	120	79	3.8	4.8	5.0	145	0.0	40.3	0.04	0.21	0.10	1	6	2
Lait De Vache, Caillé	121	69	3.8	4.9	2.6									1
Lait De Chèvre, Frais	122	84	3.4	4.9	7.0	160	0.1	25.0	0.06	0.22	0.40	1		2
Lait En Poudre	124	496	26.3	26.7	38.4	912	0.5	280.0	0.28	1.21	0.60	9		3
Lait Concentré, Sucré	125	321	7.9	8.7	54.4	284	0.2	81.0	0.09	0.42	0.20	3		3
FATS AND OILS (*tulu*)														
Beurre De Karité	130	868	1.0	96.0										10
Huile D'Arachide	131	884	0.0	100.0	0.0	0	0.0		0.00	0.00	0.00	0		7
Huile De Palme	132	890	0.0	99.0	0.0	6	0.0	5833.3	0.01	0.02	0.00		0	2
SUGARS														
Sucre Blanc (*sukaro*)	140	375	0.0	0.0	100.0	0	0.0	0.0	0.00	0.00	0.00	0		2
Miel (*di*)	141	312	0.3	0.0	84.4	6	0.9	0.0	0.01	0.03	0.10	2		3
Canne à Sucre (*timikala*)	145	54	0.6	0.1	13.0	8	1.4		0.02	0.01	0.10	3		2

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

FOOD	FOOD CODE[1]	ENERGY (kcal)	PROTEIN (g)	FAT (g)	CARBO-HYDRATE (g)	CALCIUM (mg)	IRON (mg)	VITAMIN A (µg)[2]	THIAMINE (B1) (mg)	RIBOFLAVIN (B2) (mg)	NIACIN (mg)	VITAMIN C (mg)	FOLIC ACID (µg)	SOURCE (end-notes)
BEVERAGES														
Café	150	1	trace	trace	trace	2	0.1	0.0	0.00	trace	0.30	0		6
Thé (*dite*)	151	2	0.1			5	0.2							9
Boissons Gazeuses (Limonade, Coca, Etc.)	152	46	0.0	0.0	12.0	10		0.0	0.00	0.00	0.00	0		6
Hydromel	154	55	0.2	0.2	6.8	2	0.5		0.04					1
Bière Non Décanté (*dolo*)	158	117	2.6		21.2									1
Café + Sucre	159	41	0.1	0.0	10.4	2	0.4	0.0	0.00	0.00	0.20	0		3
Thé + Sucre	160	40	0.0	0.0	10.3	0	0.0	0.0	0.00	0.01	0.00	0		3
Bière, Décanté	162	31	0.5		3.6	1	0.6		0.04	0.05	0.40			1
MISCELLANEOUS														
Cube Maggi	170	170	17.3	4.0	16.1	180	2.2	0.0	0.20	0.24	3.30	0		3
Vinaigre	171	10	0.0	0.0	4.3	9	1.2	0.0	0.03	0.03	0.90	0		3
Gingembre (*nyamaku*)	176	301	7.6	2.9	72.4	180		20.0	0.16	0.27	8.40	0		1
Noix de Kola (*woro*)	177	148	2.2	0.4	33.7	58	2.0	4.2	0.03	0.03	0.60	54		1
Bonbon (*sogosogo*)	178	386	0.0	1.1	97.2	21	1.9	0.0	0.00	0.00	0.00	0		6
Chewing Gum	179	317			95.2			0.0	0.00	0.00	0.00	0		6
Biscuit	180	464	8.0	17.3	69.6	67	1.5	0.0	0.08	0.10	0.50	0		4
Mayonnaise	183	718	1.1	79.9	2.2	18	0.5	80.0	0.06	0.11	trace	0		3, 6
Levure	185	284	40.0	1.6	45.1	50	20.0	0.0	2.30	4.70	35.00	trace		3, 6

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

FOOD	FOOD CODE[1]	ENERGY (kcal)	PROTEIN (g)	FAT (g)	CARBO-HYDRATE (g)	CALCIUM (mg)	IRON (mg)	VITAMIN A (μg)[2]	THIAMINE (B1) (mg)	RIBOFLAVIN (B2) (mg)	NIACIN (mg)	VITAMIN C (mg)	FOLIC ACID (μg)	SOURCE (end-notes)
PREPARED FOODS														
Galette d'Haricôt	191	384	8.4	27.5	30.7	51	2.9		0.25	0.05	0.80	0		1
Sardine, en Boîte	198	208	24.6	11.5	0.0	382	2.9	67.0	0.08	0.27	5.20	0		3
Galette de Mil ou Sorgho (*furufuru, ngomi*)	202	290	4.7	12.4		11	1.3							10
Gateaux de Blé, Sucré (*farini*)	203	330	4.7	12.6	49.8	23	1.8	trace	0.08	0.03	0.60	0		1
Farine d'Haricôt	2213	143	6.2	5.7	18.1	23	1.8							1

Notes

1. The food codes correspond to the compilers' coding scheme developed for their food consumption and expenditure databases. The specific numbers are used to uniquely define each food product and have no meaning in and of themselves.

2. Vitamin A values in the table are micrograms (μg) of retinol equivalent. One microgram of retinol is equal to six micrograms of beta-carotene. One International Unit (IU) of Vitamin A is equal to 0.3 micrograms of retinol.

3. "Trace" denotes that there is a small, but unmeasurable amount of the nutrient present.

Blank spaces mean that no values were reported for the given nutrient in any of the sources.

In choosing among the sources, more recent sources (particularly source #2) were preferred due to advances in nutrient analysis technology. Sources which relied on analyses of foods of African origin were also preferred. Since many of the listed sources are secondary sources themselves, efforts were made to cite the original source wherever possible.

APPENDIX III: FOOD COMPOSITION TABLE FOR MALI
(per 100 grams of edible portion)

Compiled by Shelly Sundberg and Alayne Adams

Sources used in Compiling the Food Composition Table for Mali:

1. Wu Lueng, Woot-Tsuen, Felix Busson, and Claude Jardin (1968) Food Composition Table for Use in Africa. Bethesda, Maryland: U.S. Department of Health, Education, and Welfare and FAO.

2. West, C.E., F. Pepping, and C.R. Temalilwa, eds. (1988) The Composition of Foods Commonly Eaten in East Africa. Wageningen, Netherlands: Wageningen Agricultural University 1988.

3. FAO (1988) "Food Composition Table for Togo," computer printout supplied through personal communication from the Food Policy and Nutrition Divsion, FAO. Rome: FAO.

4. FAO (1989) "Food Composition Table for Morocco," computer printout supplied through personal communication from the Food Policy and Nutrition Division, FAO. Rome: FAO.

5. McCrae, J.E., and A.A. Paul (1979) Foods of Rural Gambia. Cambridge: Medical Research Council Dunn Nutrition Unit.

6. Watt, Bernice K., and Annabel L. Merrill (1963) Composition of Foods: Raw, Processed, Prepared. Agriculture Handbook No. 8. Washington: U.S. Department of Agriculture.

7. U.S. Department of Agriculture (1971) Nutritive Value of Foods. Home and Garden Bulletin No. 72. Washington: U.S. Department of Agriculture.

8. Wu Lueng, Woot-Tsuen, R.R. Butrum, and F.H. Chang (1972) Food Composition Table for Use in East Asia. Bethesda, Maryland: U.S. Department of Health, Education, and Welfare and FAO.

9. Wu Lueng, Woot-Tsuen, and Marina Flores (1961) Food Composition Table for Use in Latin America. Bethesda, Maryland: U.S. Department of Health, Education, and Welfare and the Institute of Nutrition for Central America and Panama.

10. Mondot-Bernard, Jacqueline (1980) Satisfaction of Food Requirements and Agricultural Development in Mali. Volume I: Results of Food Consumption Survey. Paris: Organization for Economic Cooperation and Development.

In addition, the following three references were used to translate local (Bambara) names into Latin, English, and/or French:

1. FAO (1970) List of Foods Used in Africa, 2nd ed. rev. Nutrition Information Documents Series No. 2. Rome: FAO.
2. Peace Corps/Mali (n.d.) Glossaire Des Noms en Bambara. Bamako: Peace Corps.
3. Bailleul, Père C (1981) Petit Dictionnaire Bamabara-Français Français-Bamabara. England: Avebury Publishing Company.

APPENDIX IV: THE ENERGY COST OF AGRICULTURAL ACTIVITY

APPENDIX IV: THE ENERGY COST OF AGRICULTURAL ACTIVITY

CODE	activity	kcal/min	kJ/min	source[a]
101	male-sleep	1.18	4.93	1
102	male-lie	1.39	5.81	1
103	male-sit	1.38	5.77	1
104	male-stand	1.44	6.02	1
105	male-eat	1.89	7.90	3
106	male-wash/dress	3.30	13.80	5
107	male-walk/slow	2.94	12.30	1
108	male-walk/med	3.59	15.00	1
109	male-walk/fast	4.21	17.60	1
111	male-hair cut/shave	2.74	11.45	5
112	male-ceremony	2.00	8.36	6
113	male-dance	4.21	17.60	1
115	male-pray/ablution	1.50	6.27	6
116	male-games	1.78	7.44	5
118	male-write	1.22	5.10	1
120	male-hand sew	1.79	7.50	1
121	male-machine sew	2.39	10.00	1
122	male-make rope	2.58	10.80	3
123	male-make calabash	3.11	13.00	1
124	male-make basket	2.58	10.80	3
131	male-repair transport	3.09	12.90	5
132	male-repair tools	3.09	12.90	5
133	male-repair shoes	2.20	9.20	5
134	male-repair radio	1.60	6.70	5
136	male-gather in bush	3.30	13.80	6
139	male-to/fro donkey cart	1.38	5.77	1
140	male-to/fro cycling	4.40	18.40	1
142	male-clear	6.94	29.00	1
143	male-gather in field	3.50	14.63	6
144	male-burn	1.44	6.02	1
147	male-spread manure	3.80	15.88	6
148	male-hoe	5.10	21.30	1
150	male-seed w/daba	3.92	16.40	1
151	male-guide animal	3.59	15.00	1
153	male-weed w/daba	3.78	15.80	1
156	male-guide plough	4.80	20.06	6
157	male-harvest	3.30	13.79	6
158	male-unearth p.nuts	3.90	16.30	1
160	male-collect stalks	3.00	12.54	6
161	male-thresh	2.70	11.29	6
162	male-cut millet	2.39	10.00	1
165	male-hand shell	1.50	6.27	6
166	male-machine shell	6.29	26.30	5
167	male-tend animals	3.00	12.54	6
168	male-milk animals	4.69	19.60	5
170	male-general agri	4.00	16.72	6
172	male-sell/purchase	2.50	10.45	6
177	male-sort	1.77	7.40	1
178	male-fd prep	1.77	7.40	1
180	male-divide/cool	1.77	7.40	1
181	male-general domestic	3.20	13.38	6
184	male-fetch water	4.10	17.14	6
186	male-gather fuel	3.80	15.90	1
187	male-carry load on head	3.40	14.20	6
188	male-load	3.59	15.00	1
189	male-chop wood	4.59	19.20	1
194	male-sweep	3.80	15.90	5
195	male-gen house repair	3.00	12.54	6
196	male-make bricks	3.30	13.80	1
197	male-make banco walls	1.70	7.10	1

APPENDIX IV: THE ENERGY COST OF AGRICULTURAL ACTIVITY

CODE	activity	kcal/min	kJ/min	source[a]
198	male-mix banco	4.90	20.50	1
199	male-dig	6.36	26.60	1
200	male-child care	2.18	9.10	3
202	male-blacksmith	2.40	10.03	5
203	male-chat/visit	1.40	5.85	6
204	male-cut straw	5.60	23.40	1
205	male-carve wood	2.61	10.90	5
301	female-sleep	1.06	4.41	2
302	female-lie	1.24	5.19	2
303	female-sit	1.29	5.40	2
304	female-stand	1.35	5.65	2
305	female-eat	1.89	7.90	3
306	female-wash/dress	3.30	13.80	5
307	female-walk/slow	2.20	9.20	5
308	female-walk/med	3.01	12.60	2
309	female-walk/fast	3.40	14.20	5
312	female-ceremony	1.70	7.12	6
313	female-dance	3.01	12.60	2
315	female-pray/ablution	2.00	8.36	6
320	female-hand sew	1.40	5.85	6
325	female-gin/spin	1.08	4.50	3
326	female-shea nut prod	2.80	11.70	6
333	female-repair shoes	1.39	5.80	5
336	female-gather bush	2.80	11.70	6
343	female-gather fields	3.21	13.40	6
348	female-hoe	4.33	18.10	2
350	female-seed w/daba	3.80	15.90	2
351	female-guide animal	3.01	12.60	2
352	female-weed	1.94	8.11	4
353	female-weed w/daba	2.77	11.58	4
356	female-guide plough	4.40	18.40	6
357	female-harvest	3.00	12.54	6
358	female-unearth g.nuts	3.95	16.50	4
359	female-remove g.nuts	1.60	6.70	4
360	female-collect stalks	2.80	11.70	6
362	female-cut millet	2.05	8.60	4
365	female-hand shell	1.41	5.89	4
367	female-tend animals	2.80	11.70	6
368	female-milk animals	3.70	15.47	2
370	female-general agri	3.70	15.47	6
372	female-sell/purchase	2.00	8.36	6
374	female-pound	4.55	19.00	2
375	female-wash cereal	2.00	8.36	4
376	female-winnow/sieve	1.61	6.73	4
377	female-sort	1.60	6.70	4
378	female-food prep	1.57	6.56	4
380	female-divide/cool	1.49	6.23	4
381	female-gen domestic	2.00	8.36	6
382	female-grind g.nuts	2.52	10.53	4
384	female-fetch water	4.09	17.10	2
386	female-gather fuel	3.00	12.54	6
387	female-carry load on hd	3.51	14.67	4
389	female-chop wood	4.55	19.00	2
391	female-wash clothes	3.23	13.50	2
392	female-hang/fold clothes	2.63	11.00	5
393	female-wash dishes	2.23	9.28	4
394	female-sweep	3.22	13.46	4
400	female-gen child care	1.39	5.80	3
403	female-chat/visit	1.60	6.67	6
407	female-stir/chop	3.70	15.60	2

1 Brun T., F.M. Bleiberg and S. Goihman (1981) Energy expenditure of male farmers in dry and rainy seasons in Upper Volta. British Journal of Nutrition 45:67-75.

2 Bleiberg F.M. (1980) Duration of activities and energy expenditure of female farmers in dry and rainy seasons in Upper Volta. British Journal of Nutrition 43:71-82.

3 Montgomery E. and A.W Johnson (1977) Machiguenga energy expenditure. Ecology of Food and Nutrition 6:97-105.

4 Lawrence M., F. Lawrence, T.J. Cole, W.A. Coward, J. Singh and R.G. Whitehead (1985) The energy cost of common daily activities in African women: increased expenditure in pregnancy. American Journal of Clinical Nutrition 42: 753-763.

5 Altman P.L. and D.S. Dittmer (1968) (eds) Metabolism - biological handbook of the Federation of American Societies for Experimental Biology, p. 355-361.

6 Brun T. (1984) Physiological measurement of activity among adults under free-living conditions. In: Energy intake and activity (Vol. II), edited by Pollitt, E. New York: Alan R. Liss Inc., p. 131-156.

APPENDIX V: DERIVATION OF HOUSEHOLD VARIABLES

5.0 WEALTH

The continuous variable WEALTH is developed from a check-list of assets recorded in the 1st cross-sectional survey. Each asset type in a household's possession is given a score proportional to its estimated FCFA value such that a household in possession of all asset types receives a score of 100 points. Table 5.0 presents the 13 asset types and their corresponding score and FCFA values.

Table 5.0 Derivation of Household Wealth Index

asset type	score	FCFA value
latrine	1	5000
well	7	50000
radio/tape	2	15000
bicycle	7	50000
mo-ped	22	175000
plough	6	45000
cart	19	150000
seeder	7	50000
cattle	5	35000
oxen	15	120000
goat	1	4000
donkey	5	35000
sheep	3	25000
	100	754000

Cultural barriers prevented a more detailed inventory of assets or household income in the cross-sectional survey. Not only are public declarations of wealth censured in Bamana society, but there was some initial suspicion that the survey team was connected with government tax collection. In the longitudinal study in Sebekoro, familiarity and trust with the 33 household sample, coupled with indirect observation and questioning, permitted such an inventory to be compiled over the course of the year (see ASSETS).

5.1 AU

Household au (activity unit) is a continuous variable which approximates the agricultural labour force of the household. As Table 5.1 summarizes, activity units are assigned to individual household members depending on their age, gender and health status. Age/gender group activity units are expressed as a proportion of 1.0 which represents the productive input of a healthy male aged 20-59 years. While subjective, these proportions are chosen to reflect cultural practices concerning age/gender groups and their respective roles in household agricultural production. When individual au values are summed across the household, an aggregate au value for the household is obtained.

Table 5.1 Derivation of au's (activity units)

gender	age	health	au
both	< 5	good	0
both	5-9	good	0.1
male	10-14	good	0.5
female		good	0.3
male	15-19	good	0.7
female		good	0.3
male	20-59	good	1.0
female		good	0.5
both	60+	good	0.2
both	all	poor	0

5.2 CU

Household cu (consumption unit) is a continuous variable which approximates household consumption needs. Seven age/gender groups are established, and, based on energy requirements established by WHO/FAO/UNU (1985), each group is assigned a consumption unit calculated as a proportion of the mean energy expenditure figure estimated for adult men (Table 5.3). Consumption units are allocated to individual household members and then aggregated to obtain a final cu figure for the household.

Energy expenditure values (kcal) for the first three groups are derived by calculating mean body weight based on Sebekoro findings and body weight data from similar Sudano-sahelian populations, and inserting them into FAO/WHO/UNU BMR prediction equations (FAO/WHO/UNU 1985, Benefice 1981, Brun and Bleiberg 1981). In the case of adolescents, BMR figures are based on median weight for height and age from Baldwin's standards (1925 as reproduced in WHO/FAO/UNU 1985:181). Referring to estimates of energy expenditure from Sebekoro and figures from Burkina Faso, a multiple of BMR representing activity is assigned to each age/gender group. A mean estimate of energy expenditure is obtained by multiplying these activity factors by BMR for each group.

Table 5.3 Derivation of cu's (consumption units)					
group	age	BMR (kcal)	multiple	expend (kcal)	cu
active men	16-59	1550	1.8	2790	1.0
active women	16-59	1350	1.7	2300	0.8
old/inactive	16+	1130	1.5	1700	0.6
adolescents	10-15	1330	1.7	2330	0.8[a]
young children	5-9			1840	0.65[b]
weaned infants	2-4			1430	0.5[b]
non-weaned infants	< 2			500	0.2

[a] A growth factor of 70 kcal is added to account for the average daily cost of weight gain (FAO/WHO/UNU 1985:95).
[b] Intakes * 5% to allow for a desirable level of physical activity (FAO/WHO/UNU 1985:93).

Mean expenditure values for young children and weaned infants are based on estimates of intake found in the literature which are increased by 5% to allow for a desirable level of physical activity (Ferro-Luzzi and Durnin 1981, WHO/FAO/UNU 1985:92-93). For non-weaned infants, an average kcal requirement was estimated by multiplying FAO/WHO/UNU (1985) energy intake figures per kg with NCHS/CDC median weights for children less than two years of age. This figure was corrected for the likely energy contribution of breastmilk using data on breastmilk production in Gambian women (Roberts 1982).

5.3 KINLOC

The continuous variable KINLOC (kin location) represents the strength and proximity of household kinship networks. Implicit in the derivation of this variable is the assumption that the strength of kinship networks is increased the closer and more numerous are extended kin. In the first cross-sectional survey, household heads were asked to list extra-household kin and their location in relation to the village. Each kin member cited receives a score of 1 which is adjusted depending on their spatial and genealogical proximity to the household. Kin residing in the same village are weighed more heavily (*0.4) than those from nearby (*0.3) or distant villages (*0.2), while closely related kin receive a greater weight (*1.2) than more distant kin (*1.0). Resultant figures are summed up to provide an aggregate household figure. However, marked underestimation in the number of village kin identified by Sebekoro households during the cross-sectional survey compared with genealogical information obtained from detailed household histories conducted later in the study casts some doubt on the reliability of this variable.

5.4 DEPEND

The continuous variable DEPEND (household dependency) is a theoretical measure of the ease at which a household's active labour force can support the consumption needs of its members. Calculated by taking the ratio of a household's cu's (consumption units) to au's (activity units), it is assumed that a household with a lower, and therefore more favourable ratio will have less difficulty feeding household members than households where mouths outnumber the available labour force.

5.5 HHAGE

The categorical variable HHAGE (household age) provides a rough indicator of household life-cycle stage by designating households as either newly (0-14 years), medium-term (15-49 years) or long-established (50 years+) in the village based on estimates of household age provided by the household head. Newly-established households tend to be nuclear in composition with a labour force comprised of a household head, his spouse and young children. Long-established households are more often complex in composition, with a strong labour force comprised of the household head and his grown sons/brothers and their respective families. Some inconsistencies in data coding occurred in the case of recent separations from larger complex households and whether they should be considered newly or long-established.

5.6 AGE

The continuous variable AGE (age of the household head) is calculated using the year of birth found on household census forms. In cases where the census form was unavailable, estimates were made based on the known ages of peers in the village or local historic events.

5.7 VILLKIN

VILLKIN is a continuous variable which provides an index of the extent to which Sebekoro households are integrated into intra-village kinship networks. Different weights indicating the genealogical proximity of kin are applied to each kin member cited: close blood kin receive a weight of 1.0, kin through marriage receive a weight of 0.75, and other distantly related kin receive a score of 0.5. The sum of kin scores is divided by the number of kin cited to derive an index that facilitates household comparison.

5.8 HOUSEHOLD NUTRITIONAL SCORES

Variables representing the nutritional status of age/gender groups in the household are calculated by attaching nutritional scores to individuals within the household. These scores are aggregated according to the age-gender group to which the individual member belongs, and divided by the number of individuals in the group. Scoring follows James' CED classification scheme for adults (see Chapter IV), and NCHS standards for children and adolescents as outlined in Table 5.4. Separate scores for adults, men, women, children under 5 years and children 5-15 years are calculated in the same manner. An aggregate household nutritional score is derived by summing up the scores of individual household members and dividing by the number of individuals in the household.

Table 5.4 Derivation of Household Nutritional Scores

	ADULT MEN AND WOMEN (16+ years)			CHILDREN (0-15 years)	
variable	range	score	variable	range	score
BMI	< 16	1	W/A	< -2 sd	1
	16 to 17	2		-2 to -1 sd	2
	17 to 18.5	3		-1 to 0 sd	3
	18.5 >	4		0 >	4

5.9 ACTIVITY INDEX

A five point activity index is created against which the activity of the adult sample is evaluated. Based on informal observations of actual working patterns, the activity level of each individual is ranked according to a scale of 1=inactive through to 5=very active. In cases where direct observations were not made, the criteria used to compute activity units (Section 5.1) are employed.

APPENDIX VI: TABLES

Table 6.1a — Endogenous Characteristics of Beledugu Households by Food Security Group in 1988: mean (sd)

	Group 1 n=17	Group 2 n=52	Group 3a n=42	Group 3b n=37
	production sufficient	production deficient		
variable	consumption secure		consumption insecure 'moderate'	'severe'
wealth index (WEALTH)	50 (27.8)	33 (25.1)	28 (25.1)	20 (21.3)
married women (FEMNO)	4.8 (4.72)	2.7 (2.00)	2.3 (1.37)	2.6 (1.94)
consump units (SUMCU)	15.2 (12.49)	9.1 (5.70)	9.0 (5.03)	9.3 (6.58)
activity units (SUMAU)	8.5 (6.70)	5.1 (3.01)	5.0 (2.67)	5.2 (3.69)
hhold size (HHSIZE)	21 (17.6)	13 (7.9)	12 (7.2)	13 (9.3)
kin location index (KINLOC)	1.3 (0.93)	1.2 (0.90)	1.2 (0.83)	0.8 (0.72)
dependency (DEPEND)	1.7 (0.20)	1.9 (0.48)	1.8 (0.31)	1.8 (0.38)
age of hhold head (AGE)	57 (9.5)	53 (13.4)	52 (11.2)	48 (11.9)
hhold age index (HHAGE)	2.3 (0.77)	2.3 (0.79)	2.4 (0.73)	2.3 (0.88)

Table 6.1b Endogenous Characteristics of Beledugu Households by Food Security Group in 1989: mean (sd)

variable	Group 1 n=65	Group 2 n=47	Group 3a n=16	Group 3b n=20
	production sufficient	production deficient		
	consumption secure		consumption insecure 'moderate'	'severe'
wealth index (WEALTH)	39 (26.3)	26 (23.7)	27 (26.7)	17 (20.2)
married women (FEMNO)	3.5 (3.18)	2.2 (1.30)	2.4 (1.71)	2.0 (1.05)
consump units (SUMCU)	11.7 (9.08)	8.3 (4.65)	9.1 (4.39)	7.9 (4.01)
activity units (SUMAU)	6.6 (4.72)	4.6 (2.56)	5.3 (2.95)	4.3 (2.52)
hhold size (HHSIZE)	16 (12.9)	12 (6.6)	12 (5.7)	11 (5.2)
kin location index (KINLOC)	1.3 (0.87)	1.1 (0.63)	1.1 (0.94)	0.9 (0.77)
dependency (DEPEND)	1.7 (0.27)	1.9 (0.52)	1.8 (0.28)	1.9 (0.40)
age of hhold head (AGE)	53 (11.6)	51 (13.0)	53 (10.4)	50 (13.7)
hhold age index (HHAGE)	2.3 (0.76)	2.4 (0.79)	2.3 (0.93)	2.3 (0.79)

Table 6.4 Endogenous Characteristics of Sebekoro Households using Cross-sectional Variables by Food Security Group: mean (sd)					
variable	Group 1 n=12	Group 2 n=16	Group 3 n=5	sig[1] p	Scheffe
wealth index (WEALTH)	40.8 (23.76)	19.0 (21.83)	7.8 (4.76)	**	1 v 23
married women (FEMNO)	4.2 (2.00)	1.8 (1.11)	1.4 (0.54)	****	1 v 23
consump units (SUMCU)	14.4 (8.48)	7.5 (4.28)	5.6 (2.64)	**	1 v 23
activity units (SUMAU)	7.7 (3.94)	4.0 (2.34)	3.1 (1.43)	**	1 v 23
hhold size (HHSIZE)	20.9 (12.89)	10.8 (6.21)	8.8 (4.44)	*	1 v 2
kin location index (KINLOC)	0.9 (0.74)	0.8 (0.79)	0.3 (0.37)	N/S	N/S
dependency (DEPEND)	1.8 (0.21)	2.0 (0.78)	1.8 (0.38)	N/S	N/S
age of hhold head (AGE)	58.1 (9.33)	50.9 (10.88)	45.8 (8.47)	N/S	N/S
hhold age index (HHAGE)	2.3 (0.97)	1.9 (0.77)	1.8 (0.84)	N/S	N/S

[1] One-way analysis of variance: N/S not significant * p<0.05 ** p<0.01

Table 6.6	Endogenous Characteristics of Sebekoro Households by Food Security Group: mean (sd)				
	Group 1 n=12	Group 2 n=16	Group 3 n=5		
variable	production sufficient	production deficient 'secure'	'insecure'	f-ratio[1]	sig
net assets (ASSETS)	71,920 (52,390)	50,510 (44,250)	24,400 (17,570)	2.09	N/S
livestock (LIVESTK)	26,710 (21,630)	16,090 (16,680)	10,650 (18,440)	2.13	N/S
agri equip (AGRIEQ)	39,450 (31,950)	28,330 (28,530)	12,330 (16,900)	1.63	N/S
married women (FEMNOS)	4.2 (2.21)	2.4 (1.15)	1.4 (0.55)	7.01	**
consump units (CU)	12.7 (7.82)	6.8 (3.95)	5.3 (3.08)	4.88	*
activity units (AU)	6.8 (3.27)	3.3 (2.10)	2.0 (1.70)	7.97	**
hhold size (PC)	17.2 (11.20)	9.2 (5.52)	7.2 (4.31)	4.38	*
dependency (CU/AU)	1.8 (0.38)	2.2 (1.34)	2.29 (0.81)	0.74	N/S
vill kin index (VILLKIN)	5.4 (4.01)	2.8 (3.53)	3.2 (4.05)	1.71	N/S
age hhold head (AGE)	58 (50.9)	51 (10.9)	46 (8.5)	3.17	N/S
hhold age index (AGEHH)	2.6 (0.67)	1.8 (0.83)	2.0 (0.71)	3.60	*

[1]One-way analysis of variance: N/S not significant * p<0.05 ** p<0.01

Table 6.7 Nutritional Characteristics of Sebekoro Households by Food Security Group: mean (sd)

variable	Group 1 n=12 production sufficient	Group 2 n=16 production deficient 'secure'	Group 3 n=5 production deficient 'insecure'	f-ratio[1]	sig
energy/cu (kcal)	2643 (342)	2680 (351)	2687 (326)	0.05	N/S
protein/cu (g)	78.5 (17.22)	86.7 (15.94)	85.2 (9.02)	0.95	N/S
condiment frequency	7.7 (1.32)	7.7 (1.65)	7.7 (2.01)	0.00	N/S
hhold score	2.6 (0.41)	2.8 (0.45)	2.9 (0.79)	0.58	N/S
adult score	3.5 (0.55)	3.5 (0.41)	3.8 (0.23)	0.76	N/S
male score	3.5 (0.62)	3.6 (0.61)	4.0 (0.00)	1.45	N/S
female score	3.4 (0.63)	3.4 (0.74)	3.3 (0.84)	0.08	N/S
adolescent score	1.8 (0.47)	2.2 (0.68)	2.3 (0.70)	1.45	N/S
child score	2.1 (0.51)	1.8 (0.69)	1.0 (0.00)	3.87	*

[1] One-way analysis of variance: N/S not significant * $p<0.05$

Table 6.9 Mean Annual Cereal Inflows (kg/cu) in Sebekoro Households by Food Security Group: mean (sd)

	Group 1 n=12	Group 2 n=16	Group 3 n=5		
variable	production sufficient	production deficient 'secure'	'insecure'	f-ratio[1]	sig
produce	430 (129.8)	199 (161.7)	162 (137.3)	10.21	***
purchase	5 (10.4)	96 (108.0)	115 (167.0)	3.71	*
salaries received	5 (9.0)	12 (17.7)	63 (115.6)	3.25	N/S
recalled loans	4 (9.1)	2 (7.2)	0	0.43	N/S
credit received	10 (7.0)	20 (18.0)	11.1 (11.7)	2.08	N/S
gifts received	13 (7.9)	41 (65.2)	48 (37.3)	1.46	N/S
alms received	0	17 (66.5)	0	0.53	N/S

[1]One-way analysis of variance: N/S not significant * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Table 6.10 Mean Annual Cereal Outflows (kg/cu) in Sebekoro Households by Food Security Group: mean (sd)					
	Group 1 n=12	Group 2 n=16	Group 3 n=5		
variable	production sufficient	production deficient 'secure'	'insecure'	f-ratio[1]	sig
consume	283 (45.1)	295 (52.9)	294 (22.9)	0.26	N/S
sell	25 (29.4)	41 (92.6)	17 (23.1)	0.34	N/S
salaries given	27 (16.1)	9 (11.1)	6 (9.7)	7.83	**
debts repayed	7 (13.1)	3 (6.2)	8 (11.5)	0.89	N/S
credit given	0.2 (0.5)	1.6 (4.0)	0	1.14	N/S
gifts given	43 (31.6)	12 (9.7)	10 (15.4)	8.24	**
alms given	38 (17.7)	19 (18.4)	18 (16.0)	4.51	*

[1] One-way analysis of variance: N/S not significant * $p<0.05$ ** $p<0.01$

Table 6.11 Mean Annual Expenditure (FCFA/PC) in Sebekoro Households by Food Security Group: mean (sd)

	Group 1 n=12	Group 2 n=16	Group 3 n=5		
variable	production sufficient	production deficient 'secure'	 'insecure'	f-ratio[1]	sig
net expenditure	35,450 (17,710)	38,930 (23,120)	37,480 (21,920)	0.09	N/S
taxes/fines	2680 (1430)	2220 (2140)	2480 (1840)	0.21	N/S
debt payment	4620 (3000)	4410 (4260)	5070 (4660)	0.05	N/S
luxury goods	6930 (5580)	7000 (5530)	9200 (11,680)	0.23	N/S
money gifts	1180 (1680)	910 (1780)	390 (190)	0.42	N/S
agricultural goods	6110 (9300)	2910 (3370)	4210 (5860)	0.84	N/S
domestic goods	4100 (2170)	6580 (4480)	5200 (3470)	1.60	N/S
education/ health	3470 (3070)	1560 (1160)	1670 (980)	3.17	N/S
cereal purchases	200 (360)	5440 (9660)	3310 (3810)	1.94	N/S
condiment purchases	6170 (3830)	7910 (4770)	5940 (1600)	0.79	N/S

[1]One-way analysis of variance: N/S not significant

Table 7.11 The Onset of Seasonal Food Security Strategies in 1988 by Food Security Group: 148 households, 7 villages, Bèlèdugu, Mali

	Group 2 n=52	Group 3a n=42	Group 3b n=37
strategy	consumption secure	consumption insecure 'moderate'	'severe'
empty granary	mid Aug	early Aug	early July
cropping techniques: - maize harvest - premat harvest	 late Sept early Oct	 late Sept late Sept	 late Sept late Sept
labour sale	early Aug	late Aug	late July
remunerative acts and asset sale	late Aug	early Aug	mid July
claims and transfers: - gifts - credit	 late Aug late Aug	 mid Aug late Aug	 mid Aug early July
dietary change: - rationing - wild foods w/cereal - wild foods alone	 none none none	 late Aug early Sept early Sept	 late July late Aug early Sept

Table 7.12a Cereal (kg/cu) Procured from Different Strategies by Food Security Group in 1988: mean (sd)				
	148 households, 7 villages, Bèlèdugu, Mali			
	Group 2 n=52	Group 3a n=42	Group 3b n=37	
variable	consumption secure	consumption insecure 'moderate'	'severe'	I
labour sale	6 (18.9)	7 (11.4)	36 (50.7)	****
remun acts	15 (45.8)	4 (10.9)	24 (50.9)	N/S
asset sale	22 (39.6)	16 (28.5)	12 (25.7)	N/S
gift	13 (24.4)	12 (27.9)	6 (13.4)	N/S
credit/free	10 (32.1)	7 (16.4)	5 (15.2)	N/S
credit/interest	3 (9.3)	2 (7.9)	1 (5.5)	N/S

I One-way analysis of variance: N/S not significant **** p<0.0001

Table 7.12b	Cereal (kg/cu) Procured from Different Strategies by Food Security Group in 1989: mean (sd)			
	148 households, 7 villages, Bèlèdugu, Mali			
	Group 2 n=47	Group 3a n=16	Group 3b n=20	
variable	consumption secure	consumption insecure 'moderate'	 'severe'	I
labour sale	25 (62.6)	31 (53.0)	46 (72.0)	N/S
remun acts	18 (38.9)	1 (3.3)	8 (22.0)	N/S
asset sale	14 (37.6)	7 (16.1)	16 (29.0)	N/S
gift	12 (35.0)	5 (14.7)	5 (9.1)	N/S
credit/free	6 (12.0)	2 (6.7)	3 (6.5)	N/S
credit/interest	6 (11.7)	3 (5.0)	4 (9.2)	N/S

I One-way analysis of variance: N/S not significant

Table 7.13a Food Shortage Days Supplied by Different Strategies by Food Security Group in 1988: mean (sd)

148 households, 7 villages, Bèlèdugu, Mali

variable	Group 2 n=52 consumption secure	Group 3a n=42 consumption insecure 'moderate'	Group 3b n=37 consumption insecure 'severe'	I
maize	14 (14.8)	31 (21.0)	22 (14.8)	***
premature harv	7 (16.1)	9 (19.3)	22 (21.7)	**
labour sale	10 (34.0)	10 (15.1)	33 (40.9)	**
remun acts and asset sale	33 (39.0)	24 (31.0)	47 (50.5)	*
gift	15 (39.0)	12 (25.4)	7 (17.3)	N/S
credit/free	9 (28.4)	7 (14.2)	7 (30.1)	N/S
credit/interest	4 (11.7)	6 (21.7)	3 (8.0)	N/S

I One-way analysis of variance: N/S not significant * p<0.05 ** p<0.01 *** p<0.001 **** p<0.0001

Table 7.13b Food Shortage Days Supplied by Different Strategies By Food Security Group in 1989: mean (sd)

148 households, 7 villages, Bèlèdugu, Mali

	Group 2 n=47	Group 3a n=16	Group 3b n=20	
variable	consumption secure	consumption insecure 'moderate'	 'severe'	I
maize	14 (15.7)	25 (22.8)	28 (20.2)	**
premature harv	8 (17.7)	12 (20.1)	15 (19.4)	N/S
labour sale	9 (24.6)	16 (17.3)	29 (28.3)	*
remun acts and asset sale	25 (32.9)	22 (39.0)	22 (31.0)	N/S
gift	11 (37.0)	8 (19.6)	14 (28.0)	N/S
credit/free	5 (14.7)	3 (6.8)	2 (5.5)	N/S
credit/interest	7 (13.0)	4 (10.2)	7 (15.6)	N/S

I One-way analysis of variance: N/S not significant * $p<0.05$ ** $p<0.01$ *** $p<0.001$ **** $p<0.0001$

BIBLIOGRAPHY

Albergel, J. and M. Grouziz (1985) Secheresse au Sahel: incidence sur les ressources en eau et les productions vegetales, Orstom: Ouagadougou.

Altman, P.L. and D.S. Dittmer (1968) Metabolism - biological handbook of the Federation of American Societies for Experimental Biology, p. 355-361.

Ancey, G. (1974) Facteurs et systemes de production dans la societe Mossi d'aujourd'hui, ORSTOM: Centre de Ougadougou.

Annegers, J.F. (1973) Seasonal food shortages in West Africa. Ecology of Food and Nutrition 2:251-257.

Backett, E.M., A.M. Davies and A. Petros-Barvazian (1984) The risk approach to health care: with special reference to maternal and child health, including family planning, Geneva: World Health Organization.

Bahuchet, S. (1988) Food supply uncertainty among the Aka Pygmies Lobaye, Central African Republic. In: Coping with uncertainty in food supply, edited by de Garine, D.E. and G.A. Harrison. Oxford: Oxford University Press, p. 118-149.

Bailleul, P.C. (1981) Petit dictionnaire Bambara-Francais Francais-Bambara, England: Avebury Publishing Company.

Beaton, G.H., J. Milner and P. Corey (1979) Sources of variance in 24-hour dietary recall data: implications for nutrition study and interpretation. American Journal of Clinical Nutrition 32:2546-2559.

Becker, B. (1986) Wild plants for human nutrition in the Sahelian zone. Journal of Arid Environment 11:61-64.

Becker, L.C. (1989) Conflict and complementarity in Bamana farming. In: Unpublished Thesis: University of London.

Benefice, E. and S. Chevassus-Agnes (1985) Variations anthropometriques saisonnieres des adultes appartenant a deux populations differentes de l'Afrique de l'Ouest. Revue d'Epidemiologie et de Sante Publique 33:150-160.

Benefice, E. and et al. (1981) Surveys on nutritional status in semi-arid tropical areas (Sahel 1976-79): methods and results. In: Nutritional status of the rural population of the Sahel, Ottawa: International Development Research Centre.

Bingham, S.A. (1987) The dietary assessment of individuals; methods, accuracy, new techniques and recommendations. In: Nutrition abstracts and reviews (Series A) Cambridge: University of Cambridge and Medical Research Council.

Binswanger, H.P. and J. McIntire (1987) Behavioural and material determinents of production relations in land-abundant tropical agriculture. Economic and Cultural Change 36(1):73-100.

Blau, P.M. (1964) Exchange and power in social life, New York: J. Wiley.

Bledsoe, C.H., D.C. Ewbank and U.C. Isiugo-Abanihe (1988) The effect of child fostering on feeding practices and access to health services in rural Sierra Leone. Social Science and Medicine 27(6):627-636.

Bleiberg, F.M. (1980) Duration of activities and energy expenditure of female farmers in dry and rainy seasons in Upper-Volta. British Journal of Nutrition 43:71-82.

Brasseur, G. (1961) Etude de geographie regionale: le village de Tenentou (Mali). Bulletin de l'IFAN 23(3-4):607-675.

Bray, J.H. and S.E. Maxwell (1985) Multivariate analysis of variance, London: Sage Publications.

Briend, A., K.Z. Hasam, A. Aziz, B.A. Hoque and F.J. Henry (1989) Measuring change in nutritional status: a comparison of different anthropometric indices and the sample size required. European Journal of Clinical Nutrition 43:769-778.

Brown, K.H., R.E. Black, A.D. Robertson and S. Becker (1985) Effects of season and illness on the dietary intake of weanlings during longitudinal studies in rural Bangladesh. American Journal of Clinical Nutrition 41:343-355.

Brun, T., F.M. Bleiberg and S. Goihman (1981) Energy expenditure of male farmers in dry and rainy seasons in Upper Volta. British Journal of Nutrition 45:67-75.

Brun, T. (1984) Physiololgical measurement of activity among adults under free living conditions. In: Energy intake and activity: current topics in nutrition and disease (Vol. II) edited by Pollitt, E. New York: Alan R. Liss Inc., p. 131-156.

Bulletin S.A.P. (1986-90) Comité National d'actions d'urgence et de réhabilitation, Projet système d'alerte précoce, Bamako, Mali: Ministere de l'administration territoriale et du developpement a la base.

Cadelina, R.V. (1985) In time of want and plenty: the Batak experience, Dumaguete City, Philippines: Silliman University.

Campbell, D.J. and D.D. Trechter (1982) Strategies for coping with food consumption shortage in the Mandara mountain region of North Cameroon. Social Science and Medicine 16:2117-2127.

Campbell D. (1990) Community-based strategies for coping with food scarcity: a role in African famine early-warning systems. GeoJournal 20(3).

Chambers, R., R. Longhurst and P. Pacey (1981) Seasonal dimensions to rural poverty, London: Francis Pinter.

Chambers, R. (1983) Seasonality, poverty and nutrition: a professional frontier, Coimbatore: Paper presented at the EFNAG national workshop on poverty and malnutrition.

Chambers, R. (1988) Editorial Introduction: Vulnerability, Coping and Policy. IDS Bulletin 20(2):1-7.

Chen, L.C., A. Chowdhury and S.L. Huffman (1980) Anthropometric assessment of energy protein malnutrition and subsequent risk of mortality among preschool aged children. American Journal of Clinical Nutrition 33:1836-1845.

Corbett, J. (1988) Famine and household coping strategies. World Development 16(9):1099-1112.

Cronk, C.E. and A.F. Roche (1982) Race and sex-specific reference data for triceps and subscapular skinfolds and weight/stature. American Journal of Clinical Nutrition 35:347-354.

Cutler, P. (1984) Famine forcasting: prices and peasant behaviour in Northern Ethiopia. Disasters 8(1):48-56.

Cutler, P. (1986) The response to drought of Beja famine refugees in Sudan. Disasters 10(3):181-188.

Das, B.S., D.B. Das, R.N. Satpathy, J.K. Patnaik and T.K. Bose (1988) Riboflavin deficiency and severity of malaria. European Journal of Clinical Nutrition 42:277-283.

Davies S., M. Buchanan-Smith and R. Lambert (1991) Early-warning in the Sahel and Horn of Africa: the state of the art: a review of the literature. IDS Research Report No. 20, Institute of Development Studies, University of Sussex, December 1991.

de Garine, I. and G. Koppert (1988) Coping with seasonal fluctuations in food supply among savanna populations: the Massa and Mussey of Chad and Cameroon. In: Coping with uncertainty in food supply, edited by de Garine, D.E. and G.A. Harrison. Oxford: Oxford University Press, p. 210-259.

DeWaal, A. (1985) Survival in Northern Darfur 1985-86, Nyala, Sudan: Report of the S.C.F. survey team.

DeWaal, A. (1989) Famine that kills: Darfur, Sudan 1984-1985, Oxford: Clarendon Press.

Delisle, H., M. Alladoumgue, F. Begin, K. Nandjingar and C. Lasorsa (1991) Household food consumption and nutritional adequacy in Wadi zones of Chad, Central Africa. Ecology of Food and Nutrition 25:229-248.

Dessalegn, R. (1988) Peasant survival strategies in Ethiopia. Disasters 12(4):326-343.

Dettwyler, K.A. (1986) Infant feeding in Mali, West Africa: variations in belief and practice. Social Science and Medicine 23(7):651-664.

Dettwyler, K.A. (1987) Breastfeeding and weaning in Mali: cultural context and hard data. Social Science and Medicine 24(8):633-644.

Devereux, S. (1991) Coping strategies in North-East Ghana. In: Unpublished draft chapter of D.Phil thesis, Oxford: Oxford University.

Diaz, E., G.R. Goldberg, M. Taylor, et al (1991) Effects of dietary supplementation on work performance in Gambian labourers. American Journal of Clinical Nutrition 53:803-811.

Dibley, M.J., N. Staehling, P. Nieburg and F.L. Trowbridge (1987) Interpretation of Z-score anthropometric indicators derived from the international growth reference. American Journal of Clinical Nutrition 46:749-762.

Dirks, R. (1980) Social responses during severe food shortages and famine. Current Anthropology 21(1):21-44.

Dugdale, A.E. and P.R. Payne (1977) Patterns of lean and fat deposition in adults. Nature 266:349-351.

Durnin, J.V.G.A. and R. Passmore (1967) Energy, work and leisure, London: Heinemann Educational Books.

Durnin, J.V.G.A. and J. Womersley (1974) Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged 16 to 72 years. British Journal of Nutrition 32:77-97.

Eide, W.B., A. Oslaug, M. Wandel and G. Holmboe-Ottesen (1986) Introducing nutritional considerations into rural development programs with a focus on agriculture: a summary of 2 research reports, Olso, Norway: University of Olso.

Evans, T. (1989) The socio-economic consequences of human diseases on subsistence agriculture: the case of onchocerciasis in West Africa. In: Unpublished PhD thesis: University of Oxford.

Evans-Pritchard, E.E. (1940) The Nuer, Oxford: Clarendon Press.

Eveleth, P.B. (1985) Nutritional implications of differences in adolescent growth and maturation and in adult body size. In: Nutritional adaptation in man, edited by Blaxter, S.K. and J.C. Waterlow. London: John Libbey Inc., p. 31-43.

FAO (1970) List of foods used in Africa. In: Nutrition information document series No. 2, Rome: FAO.

FAO (1988) Food composition table for Morocco. In: a computer printout supplied through personal communcation, Rome: Food Policy and Nutrition Division, FAO.

FAO (1989) Mali: apercu nutritionnel ESN.

FAO (1990) Production Yearbook 1989; Vol 43. FAO: Statistic series no 94.

FAO/WHO (1962) Calcium requirements. In: Report of a joint FAO/WHO expert group. Technical Report Series No. 230, Geneva: World Health Organization.

FAO/WHO (1967) Requirements of Vitamin A, Thiamine, Riboflavin, and Niacin. In: Report of a joint FAO/WHO expert group. Technical Report Series No. 362, Geneva: World Health Organization.

FAO/WHO (1970) Requirements of ascorbic acid, vitamin D, vitamin B12, folate and iron. In: Report of a joint FAO/WHO expert group. Technical Report Series No. 452, Geneva: World Health Organization.

FAO/WHO (1988) Requirements of vitamin A, iron, folate and vitamin B12. In: Report of a joint FAO/WHO expert consultation. FAO Food and Nutrition Series No. 23, Rome: Food and Agriculture Organization of the United Nations.

FAO/WHO/UNU (1985) Energy and protein requirements: report of the joint FAO/WHO/UNU expert consultation. In: Technical report series 724, Geneva: World Health Organization.

Ferro-Luzzi, A. (1984) Energy intakes as predictors of energy balance in free-living populations. In: Energy intake and activity, New York: Alan R. Liss. Inc., p. 79-99.

Ferro-Luzzi, A. (1985) Work capacity and productivity in long-term adaptation to low energy intakes. In: Nutrition adaptation in man, edited by Blaxter, S.K. and J.C. Waterlow. London: John Libbey Inc., p. 61-69.

Ferro-Luzzi, A., G. Pastore and S. Sette (1987) Seasonality in energy metabolism. In: Chronic energy deficiency: consequences and related issues, p. 37-57.

Firth, R. (1959) Social change in Tikopia, New York: MacMillan.

Fleuret, A. (1986) Indigenous responses to drought in Sub-Saharan Africa. Disasters 10(3):224-229.

Forbes, G.B. and J.C. Reina (1970) Adult lean body weight declines with age: some longitudinal observations. Metabolism 19:653-663.

Fortes, M. (1949) The web of kinship of the Tallensi, Oxford: Oxford University Press.

Fortes, M. and S.L. Fortes (1936) Food in the domestic economy of Tallensi. Africa 9:237-275.

Foster, G.M. (1961) The dyadic contract: a model for the social structure of a Mexican peasant village. American Anthropologist 63:1173-1192.

Fox, R.H. (1953) A study of the energy expenditure of Africans engaged in various rural activites with special reference to some environmental and physiological factors which may influence the efficiency of their work. In: Unpublished Thesis: University of London.
Frisancho, A.R. (1990) Anthropometric standards for the assessment of growth and nutritional status, Ann Arbor: University of Michigan Press.

Fulton, D. and C. Toulmin (1982) A socio-economic study of an agro-pastoralist system in central Mali, Bamako: International Livestock Centre for Africa.

Garenne, M., B. Maire, O. Fontaine, K. Dieng and A. Briend (1987) Risques de deces associes a differents etats nutritionnels chez l'enfant d'age prescolaire, Dakar: ORANA.

Garrow, J.S. (1981) Treat obesity seriously, London: Churchill Livingstone.

Garrow, J.S. (1983) Indicies of adiposity. Nutrition Abstracts and Reviews 53(8):697-709.

Gibson, R. (1990) Principles of nutrition assessment, New York: Oxford University Press.

Giri, J. (1989) Le Sahel au XXie siecle, Paris: Editions Karthala.

Glantz, M.H. (1987) Drought and economic development in Sub-Saharan Africa. In: Drought and Hunger in Africa, edited by Glantz, M.H. Cambridge: Cambridge University Press, p. 37-58.

Goody, J. (1958) The developmental cycle in domestic groups, Cambridge: Cambridge University Press.

Gopalan, C. (1986) Vitamin A deficiency and child mortality. NFI Bulletin 7:6-7.

Guyer, J. (1981) Household and community in African studies. African Studies Review 24(213):87-137.

Harriss, B. (1982) Foodgrains marketing in the semi-arid tropics of West Africa, Hyderabad: International Crops Research Institute for the Semi-Arid Tropics.

Harriss, B., S. Gillespie and J. Pryer (1990) Poverty and malnutrition at extremes of South Asian food systems. Economic and Political Weekly 22:2783-2799.

Haswell, M.R. (1953) Economics of agriculture in a Savanna village, Colonial Research Study No. 8, London: HMSO.

Haswell, M. (1981) Energy for subsistence, London: MacMillan Press Ltd..

Henry, C.J.K. (1990) Body mass index and the limits of human survival. European Journal of Clinical Nutrition 44:329-335.

Henry, C.J.K. and D.G. Rees (1991) New predictive equations of the estimation of basal metabolic rate in tropical peoples. European Journal of Clinical Nutrition 45:177-185.

Henry, L.J. (1910) Les Bambara: leur vie, psychique, ethique, sociale, religieuse, Munster: Collection Internationale des Monographies Ethologiques Anthropos.

Hertzog, C. and M. Rovine (1985) Repeated measured analysis of variance in developmental research: selected issues. Child Development 56:787-809.

Heymsfield, S.B., C. McManus, J. Smith, V. Stevens and D.W. Nixon (1982) Anthropometric measurement of muscle mass: revised equations for calculating bone-free arm muscle area. American Journal of Clinical Nutrition 36:680-690.

Heywood, P.F. (1986) Nutritional status as a risk factor for mortality in children in the highlands of Papua New Guinea. In: Proceeedings of the XIII International Congress of Nutrition, edited by Taylor, T.G. and N.K. Jenkins. London: John Libbey Inc., p. 103-106.

Hill, P. (1972) Rural Hausa: a village and a setting, Cambridge: Cambridge University Press.

Hoyle, B., M. Yunus and L.C. Chen (1980) Breast feeding and food intake among children with acute diarrhoeal disease. American Journal of Clinical Nutrition 33:2365-2371.

Hunter, J.M. (1967) Seasonal hunger in a part of the West Africa Savanna: a survey of body weights in Nangondi North East Ghana. In: Transactions and Papers No. 41, Institute of British Geographers.

Huss-Ashmore, R. and S.H. Katz (1989) Africa food systems in crisis, Part 1: Microperspectives, London: Gordon and Breach.

ICRISAT (1984) Agroclimatology of West Africa. Mali Information Bulletin 19.

Immink, M.D.C., F.E. Viteri, R. Flores and B. Torun (1984) Microeconomic consequences of energy deficiency in rural populations in developing countries. In: Energy intake and activity, edited by Pollitt, E. and P. Amante. New York: Allan R. Liss, p. 355-376.

Imperato, P.J. (1986) Historical dictionary of Mali, Metuchen, N.J.: Scarecrow Press.

James, W.P.T., A. Ferro-Luzzi and J.C. Waterlow (1988) Definition of chronic energy deficiency in adults: report of a working party of the International Dietary Energy Consultative Group. European Journal of Clinical Nutrition 43:969-981.

Jelliffe, E.F.P. and D.B. Jelliffe (1969) Arm anthropometry in nutritional assessment: nomogram for rapid calculation of muscle circumference and cross-sectional muscle and fat mass. American Journal of Clinical Nutrition 26:912-915.

Jiggins, J. (1986) Women and seasonality: coping with crisis and calamity. IDS Bulletin 17:9-18.

Jodha, N. (1975) Famine and famine policies: some empirical evidence. Economic and Political Weekly 10(41).

Johnson, A.W. and L.C. Bond (1974) Kinship, friendship, and exchange in two communities: a comparative analysis of norms and behaviours. Journal of Anthropological Research 30(1):55-68.

Kielmann, A.A., I.S. Uberoi, R.K. Chandra and V.L. Mehra (1976) The effect of nutritional status on immune capacity and immune responses in preschool children in a rural community in India. WHO Bulletin 54:477-483.

Kirkwood B.R. (1988) Essentials of Medical statistics, London: Blackwell Scientific Publications.

Klaus, E. (1976) Tradition and progress in the African village: the non-capitalistic transformation of rural communities in Mali, London: C. Hurst and Company.

Koenig, D. (1989) National organizations and famine early warning: the case of Mali. Disasters 12(2):157-168.

Labouret, H. (1934) Les Manding et leur langues, Paris: Librairie Larose.

Labouret, H. (1941) Paysans d'Afrique occidentale, Paris: Librairie Gallimard.

Lamb, P.J. (1980) Sahelian drought. New Zealand Journal of Geography 68:12-68.

Laughlin, C.D. (1974) Deprivation and reciprocity. Man 9:380-396.

Laughlin, C.D. and I.A. Brady (1978) Extinction and survival in human populations, New York: Columbia University Press.

Lawrence, M., J. Singh, F. Lawrence and R.G. Whitehead (1985) The energy cost of common daily activities in African women: increased expenditure in pregnancy. American Journal of Clinical Nutrition 42:753-763.

Lawrence, M., W.A. Coward, F. Lawrence, T.J. Cole and R.G. Whitehead (1987) Fat gain during pregnancy in rural African women: the effect of season and dietary status. American Journal of Clinical Nutrition 45:1442-1450.

Lawrence, M. and R.G. Whitehead (1988) Physical activity and total energy expenditure of child-bearing Gambian village women. European Journal of Clinical Nutrition 42:145-160.

Leland (1989) Personal communication.

Leonard, W.R. (1991) Household-level strategies for protecting children from seasonal food scarcity. Social Science and Medicine 33(10):1127-1133.

Levfevre, D. (1988) Etude de la nutrition au Mali et perspectives: Rappport de consultation, Bamako: CESA.

Lewis, J. (1979) Descendents and crops: two poles of production in a Malian peasant village. In: Unpublished Thesis: Yale University.

Lewis, J. (1981) Domestic labour intensity and the incorporation of Malian peasants into localized descent groups. American Ethnologist 8(2):53-73.

Longhurst, R. (1986) Household food strategies in response to seasonality and famine. IDS Bulletin 17(4):27-35.

Mali (1985) Ministere du Plan. Diagnostic de la region de Koulikoro, Bamako, Mali: Comite Regionale de Developpement.

Mali (1987) Ministere du Plan. Provisional results of 1986 census, Bamako, Mali: Direction nationale de la statistique et de l'information.

Marr, J.W. (1971) Individual dietary surveys: purposes and methods. World Review of Nutrition and Dietetics 13:105-164.

Mauss, M. (1950) The gift: the form and reason for exchange in archaic societies, London: Routledge and Kegan Paul PLC.

McCrae, J.E. and A.A. Paul (1979) Foods of rural Gambia, Cambridge: Medical Research Council, Dunn Nutrition Unit.

McGregor, I.A. and et al. (1968) The growth of young children in a Gambian village. Transactions of the Royal Society of Tropical Medicine and Hygiene 62(3):341-352.

McLean, W.P. (1984) The identification of nutritional risk at the household level: a state of the art review. In: Occasional Papers No. 2, London: Department of Human Nutrition, London School of Hygiene and Tropical Medicine.

McNaughton, P.R. (1988) The Mande blacksmiths: knowledge, power and art in West Africa, Bloomington: Indiana University Press.

Meillasoux, C. (1981) Maidens, meal and money: capitalism and the domestic community, Cambridge: Cambridge University Press.

Messer, E. (1983) The household focus in nutritional anthropology: an overview. Food and Nutrition Bulletin 5(4):2-12.

Messer, E. (1989) Seasonality in food systems: an anthropological approach. In: Seasonal variability in third world agriculture, edited by Sahn, D.E.. Baltimore: John Hopkins University Press .

Michaut, E., F. Niang and V. Dan (1972) La maturation osseuse pendant la periode pubertaire. Annales de Radiologie 15:767-769.

Mingelli, Y.S., A. Charbonnier, R.G. Whitehead and E. Jequier (1990) Twenty-four hour energy expenditure and metabolic rate measured in a whole body indirect calorimeter in Gambian men. American Journal of Clinical Nutrition 51:563-570.

Miracle, M.P. (1961) Seasonal hunger: a vague concept and an unexplored problem. Bulletin de l'IFAN 22:373-383.

Mohanram, M., V. Reddy and S. Mishra (1974) Lysozyme activity in plasma and leucocytes in malnourished children. British Journal of Nutrition 32:313-316.

Mondot-Bernard, J. (1980) Satisfaction of food requirements and agricultural development in Mali, Volume 1: Results of food consumption surveys, Paris: Organization for Economic Cooperation and Development Center.

Mondot-Bernard, J. and M. Labonne (1982) Satisfaction of food requirements in Mali to 2000 A.D, Paris: OECD.

Monteil, C. (1924) Les Bambara: du Segou et du Kaarta, Paris: G.P. Maisonneuve et Larose.

Montgomery, E. and A.W. Johnson (1977) Machiguenga energy expenditure. Ecology of Food and Nutrition 6:97-105.

N'Diaye, B. (1970) Groupes ethniques au Mali, Bamako: Editions Populaires.

Norgan, N.G. (1990) Body mass index and body energy stores in developing countries. European Journal of Clinical Nutrition 44(Supp. 1):79-84.

Norman, D. (1977) The rationalization of inter-cropping. African Environment 2(3):3-21.

Norusis, M.J. (1988) SPSS/PC+ Advanced statistics V2.0, Chicago: SPSS Inc..

Nurse, G.T. (1975) Seasonal hunger among the Ngoni and Ntumba of Central Malawi. Africa 45(1):1-11.

Ogbu, J.U. (1973) Seasonal hunger in tropical Africa as a cultural phenomenon: the Onicha Ibo of Nigeria and Chakaka Poka of Malawi examples. Africa 43(4):317-332.

Pacey, A. and P.R. Payne (1985) Agricultural development and nutrition, London: Hutchison, by arrangement of FAO and UNICEF.

Pales, L.C., P.M. Tassin de Saint and A. Mayer (1954) L'alimentation en AOF milieux - enquetes - techniques - rations, Dakar: ORANA.

Paques, V. (1954) Les Bambara: monographies ethnologiques Africaines. Institute International Africain, Paris: Presses Universitaires de France.

Passmore, R. and M.A. Eastwood (1986) Human nutrition and dietetics, London: Churchill Livingstone. Ed. 8th.

Paul, A.A., E.M. Muller and R.G. Whitehead (1979) The quantitative effects of maternal dietary intake on pregnancy and lactation in rural Gambian women. Transactions of the Royal Society of Tropical Medicine and Hygiene 73:686-692.

Payne, P.R. (1985a) Appropriate indicators for project design and evaluation. In: Food aid and the well-being of children in the developing world, New York: UNICEF/WFP, p. 109-142.

Payne, P.R. (1985) Nutritional adaptation in man: social adjustments and their nutritional implications. In: Nutritional adaptation in man, edited by Blaxter, SK. and J.C. Waterlow. London: John Libbey Inc., p. 71-87.

Payne, P.R. (1990) Measuring malnutrition. IDS Bulletin 21(3):14-30.

Prentice, A.M., R.G. Whitehead, S.B. Roberts and A.A. Paul (1981) Long-term energy balance in child-bearing Gambian women. American Journal of Clinical Nutrition 34:2790-2799.

Raynault, C. (1975) Le cas de la region de Maradi (Niger). In: Secheresse et famine du Sahel, edited by Copans, J. Paris: Maspero, p. 5-42.

Reardon, T., P. Matlon and C. Delgado (1988) Coping with household-level food insecurity in drought-affected areas of Burkina Faso. World Development 16(9):1065-1074.

Richards, A.I. (1939) Land, labour and diet in Northern Rhodesia: an economic study of the Bemba tribe, Oxford: Oxford University Press.

Richards, P. (1985) Indigenous agricultural revolution: ecology and food production in West Africa, London: Hutchison.

Richards, P. (1986) Coping with hunger: hazard and experiment in an African rice-farming system, London: Allen and Unwin Ltd..

Roberts, S.B., A.A. Paul, T.J. Cole and R.G. Whitehead (1982) Seasonal changes in activity, birth weight and lactational performance in rural Gambian women. Transactions of the Royal Society of Tropical Medicine and Hygiene 76(5):668-678.

Rondeau, C. (1987) Paysannes du Sahel et strategies alimentaires. Revue internationale d'action communautaire 17/57:63-80.

Rosetta, L. (1986) Sex differences in seasonal variations of the nutritional status of Serere adults in Senegal. Ecology of Food and Nutrition 18:231-244.

Rosetta, L. (1988) Seasonal changes and the physical development of young Serere children in Senegal. Annals of Human Biology 15(3):179-189.

Rowland, M.G.M., T.J. Cole and R.G. Whitehead (1977) A quantitative study into the role of infections in determining nutritional status in Gambian village children. British Journal of Nutrition 37:441-450.

Rowland, M.G.M., A. Paul, A.M. Prentice, et al. (1981) Seasonality and growth of infants in a Gambian village. In: Seasonal dimensions of rural poverty, edited by Chambers, R., R. Longhurst and P. Pacey. London: Frances Pinter Publishers Ltd, p. 164-174.

Rowland, M.G.M., A. Paul, A.M. Prentice, et al. (1981) Seasonality and growth of infants in a Gambian village. In: Seasonal dimensions of rural poverty, edited by Chambers, R., R. Longhurst and P. Pacey. London: Frances Pinter Publishers Ltd, p. 164-174.

Sahlins, M.D. (1965) On the sociology of primitive exchange. In: The relevance of models of social anthropology, edited by Banton, M. London: Tavistock Publications, p. 139-236.

Sahn, D.E. (1989) Seasonal variability in third world agriculture, Baltimore: John Hopkins University Press.

Satyanarayana, K., T. Prasanna Krishna and B.S. Narasinga Rao (1986) Effect of early childhood undernutrition and child labour on growth and adult nutritional status of rural Indian boys around Hyderabad. Human Nutrition: Clinical Nutrition 40(C):131-139.

Schofield, S. (1974) Seasonal factors affecting nutrition in different age groups and especially preschool-children. Journal of Development Studies 11:22-40.

Schultink, W.J., W. Klaver, H. Van Wijk, J.M.A. Van Raaij and J.G.A.J. Hautvast (1990) Body weight changes and basal metabolic rates of rural Beninese women during seasons with different energy intakes. European Journal of Clinical Nutrition 44(Supp. 1):31-40.

Scott, J.C. (1976) The moral economy of the peasant: rebellion and subsistence in southeast Asia, New Haven: Yale University Press.

Seckler, D. (1982) Small but healthy: a basic hypothesis in the theory, measurement and policy of malnutrition. In: Newer concepts in nutrition and their implications for policy, edited by Sukhatme, P.V. India: Maharashtra Association for the Cultivation of Science.

Seigel S. (1956) Non-parametric statistics for the behavioural sciences, London: McGraw-Hill Book Company.

Sen A. (1981) Poverty and famines: an essay on entitlement and deprivation, Oxford: Clarendon Press.

Simmons, E.B. (1976) Calorie and protein intakes in three villages in Zaria province, May 1970 - July 1971. In: Samaru miscellaneous paper 55, Institute for Agricultural Research, Ahmadu Bello University, Nigeria,

Sinha, D.P. and F.B. Bany (1976) Protein and calorie malnutrition, cell mediated immunity and BCG vaccination in children from rural West Bengal. Lancet 2:531-534.

Siri, W.E. (1956) The gross composition of the body. Adv.Biol.Med.Phys. 4:239-280.

Society of Actuaries (1979) Build Study 1979, Chicago: Association of Life Insurance, Medical Directors of America.

Sommer, A., I. Tarwotjo, G. Hussini and D. Susanto (1983) Increased mortality in children with mild vitamin A deficiency. Lancet 2:585-588.

Spurr, G.B. (1984) Physical activity, nutritional status and physical work capacity in relation to agricultural productivity. In: Energy intake and activity, New York: Alan R. Liss Inc., p. 207-261.

Staatz, J.M., J. Dione and N.N. Bembele (1989) Cereals market liberalization in Mali. World Development 17(5):703-718.

Sukhatme, P.V. (1982) Poverty and malnutrition. In: Newer concepts in nutrition and their implications for policy, edited by Sukhatme, P.V. India: Maharashtra Association for the Cultivation of Science, p. 11-63.

Sukkar, M.Y., J.R. Kemm and M. Kardesh (1982) Age independent anthropometry: an examination of data from rural Khartoum, Sudan. Annals of Human Biology 9(3):265-275.

Sundberg, S. (1988) An overview of the food consumption and nutrition situation in Mali, Mali: a report submitted to USAID.

Swift, J. (1989) Why are rural people vulnerable to famine? IDS Bulletin 20(2):8-15.

Swindon, S.M. (1988) Drought survival tactics of subsistence farmers in Niger. Human Ecology 16(2):123-144.

Tabachnick, B.G. and L.S. Fidell (1989) Using multivariate statistics, New York: Harper and Row. Ed. 2nd.

Tanner, J.M. (1978) Foetus into man: physical growth from conception to maturity, London: Open Books Publishing.

Tanner, J.M. and P.B. Eveleth (1990) Worldwide variation in human growth, Cambridge: Cambridge University Press.

Teme, B. (1985) Systeme agraire villageois et developpement rural: une analyse a travers l'exemple de cinq villages de Beledougou au Mali. In: These de doctorat deuzieme cycle: faculte de science economique de gestation de Dijon.

Thomas, R.B. and T.L. Leatherman (1990) Household coping strategies and contradictions in response to seasonal food shortages. European Journal of Clinical Nutrition 44(Supp. 1):103-111.

Thurnham, D.I., S.J. Oppenheimer and R. Bull (1983) Riboflavin status and malaria in infants in Papua New Guinea. Transactions of the Royal Society of Tropical Medicine and Hygiene 77:423-424.

Tomkins, A. (1983) Nutritional cost of protracted diarrhoea in young Gambian children. Gut 24:495A.

Tomkins, A., D.T. Dunn and R.J. Hayes (1989) Nutritional status and risk of morbidity amongst young Gambian children allowing for social and environmental factors. Transactions of the Royal Society of Tropical Medicine and Hygiene 83:282-287.

Tomkins, A. and F. Watson (1989) Malnutrition and infection: a review, London: Clinical Nutrition Unit, London School of Hygiene and Tropical Medicine.

Toulmin, C. (1986) Access to food, dry season strategies and household size amonst the Bambara of central Mali. IDS Bulletin 17(3):58-66.

Traore, M. (1980) Atlas au Mali, Paris: Les Edition J.A..

Trimingham, J.S. (1959) Islam in West Africa, Oxford: Claredon Press.

Turrittin, J. (1988) Men, women and market trade in rural Mali, West Africa. Canadian Journal of African Studies 22(3):583-604.

U.S. Department of Agriculture, (1963) Nutritive values of foods. In: Home and Garden Bulletin, Washington D.C.: U.S. Department of Agriculture.

Van Loon, H., V. Saverys, J.P. Vuylsteke, R.F. Vlietinck and R. Eeckels (1986) Local vs universal growth standards: the effects of using NCHS as universal reference. Annals of Human Biology 13(4):347-357.

Waaler, H.T. (1984) Height, weight and mortality: the Norwegian experience, Oslo: Gruppe for Helsetjeinesteforskining.

Walsh, R.P.D. (1981) The nature of climatic seasonality. In: Seasonal dimensions to rural poverty, edited by Chambers, R., R. Longhurst and A. Pacey. London: Frances Pinter, p. 11-29.

Waterlow, J.C., R. Buzina, W. Keller, J.M. Lane, M.Z. Nichaman and J.M. Tanner (1977) The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. Bulletin of the World Health Organization 55(4):489-498.

Watt, B.K. and A.L. Merrill (1963) Composition of foods: raw, processed, prepared. In: Agriculture Handbook No. 8, Washington D.C.: U.S. Department of Agriculture.

Watts, M. (1983) Silent violence: food, famine and peasantry in Northern Nigeria, Berkeley: University of California Press.

Watts, M. (1984) The demise of the moral economy: food and famine in a Sudano-Sahelian region in historical perspective. In: Life before the drought, edited by Scott, E. New York: Allen and Unwin Inc., p. 124-148.

Watts, M. (1987) Drought, environment and food security: some reflections on peasants, pastoralists and commoditization in dryland West Africa. In: Drought and famine in Africa, edited by Glantz, M.H. Cambridge: Cambridge University Press, p. 171-211.

West, C.E., F. Pepping and C.R. Temalilwa (1988) The composition of foods commonly eaten in East Africa, Wageningen: Wageningen Agricultural University.

West, K.P., G.R. Howard and A. Sommer (1989) Vitamin A and infection: public health implications. Annual Review of Nutrition 1:351-374.

White, B. (1980) Rural household studies in anthropological perspectives. In: Rural household studies in Asia, edited by Biswanger, H. and et al.. Singapore: Singapore University Press, p. 3-26.

WHO (1990) Measuring children: the uses of anthropometry reported in SCN News 5:8-19. In: Administrative Committee on Coordination: Subcommittee on nutrition (ACC/SCN) edited by Mason, J.B.

Wolf, E.R. (1966) Kinship, friendship and patron-client relations in complex societies. In: The social anthropology of complex societies, edited by Banton, M. New York: Praeger, p. 1-22.

World Development Report (1991) Financial systems and development, World development indicators, Oxford: Oxford University Press.

Wu Lueng, W.T., W. Tsuen and M. Flores (1961) Food composition table for Latin America, Bethesda, Maryland: U.S. Department of Health, Education and Welfare and FAO.

Wu Lueng, W.T., W. Tsuen, F. Busson and C. Jardin (1968) Food composition table for use in Africa, Bethesda, Maryland: U.S. Department of Health, Education and Welfare and FAO.

Wu Lueng, W.T., W. Tsuen, R.R. Butrum and F.H. Chang (1972) Food composition table for East Asia, Bethesda, Maryland: U.S. Department of Health, Education and Welfare and FAO.

Zillikens, M.C. and J.M. Conway (1990) Anthropometry in blacks: applicability of generalized skinfold equations and differences in fat patterning between blacks and whites. American Journal of Clinical Nutrition 52:45-51.